US009448507B2

(12) **United States Patent**
Suzuki

(10) **Patent No.: US 9,448,507 B2**
(45) **Date of Patent: Sep. 20, 2016**

(54) **NOZZLE RECEIVER, POWDER CONTAINER, AND IMAGE FORMING APPARATUS**

(71) Applicant: **Michiharu Suzuki**, Kanagawa (JP)

(72) Inventor: **Michiharu Suzuki**, Kanagawa (JP)

(73) Assignee: **RICOH COMPANY, LTD.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/832,181**

(22) Filed: **Aug. 21, 2015**

(65) **Prior Publication Data**

US 2016/0070204 A1 Mar. 10, 2016

(30) **Foreign Application Priority Data**

Sep. 10, 2014 (JP) 2014-184567
Feb. 13, 2015 (JP) 2015-026838

(51) **Int. Cl.**
G03G 15/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/0886*** (2013.01)

(58) **Field of Classification Search**
CPC G03G 15/0886; G03G 15/0837; G03G 15/0839
USPC 399/258, 260, 262
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2013/0272750 A1 10/2013 Matsumoto et al.
2013/0330105 A1* 12/2013 Komatsu et al. 399/262
2014/0241757 A1 8/2014 Kikuchi et al.
2014/0270859 A1 9/2014 Hosokawa et al.
2014/0348551 A1 11/2014 Yamabe et al.
2016/0004184 A1 1/2016 Kikuchi et al.

FOREIGN PATENT DOCUMENTS

JP 2012-133349 7/2012
JP 5516833 4/2014
JP 2014-157371 8/2014
JP 2014-164107 9/2014
JP 2016-14848 A 1/2016
WO WO 2014/142362 A1 9/2014
WO WO 2015/141861 A1 9/2015

OTHER PUBLICATIONS

U.S. Appl. No. 14/558,466, filed Dec. 2, 2014.

* cited by examiner

Primary Examiner — Hoang Ngo

(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

A nozzle receiver for use with a powder container includes: a shutter to open an opening of the nozzle receiver to an opening position when the shutter is pressed by a conveying nozzle of an image forming apparatus, and to close the opening to a closing position when not being pressed by the conveying nozzle, and that includes a sealing portion for sealing the opening; a supporter to support and guide the shutter between the opening position and the closing position; and a cap to cover the supporter when the shutter is located at the closing position.

20 Claims, 20 Drawing Sheets

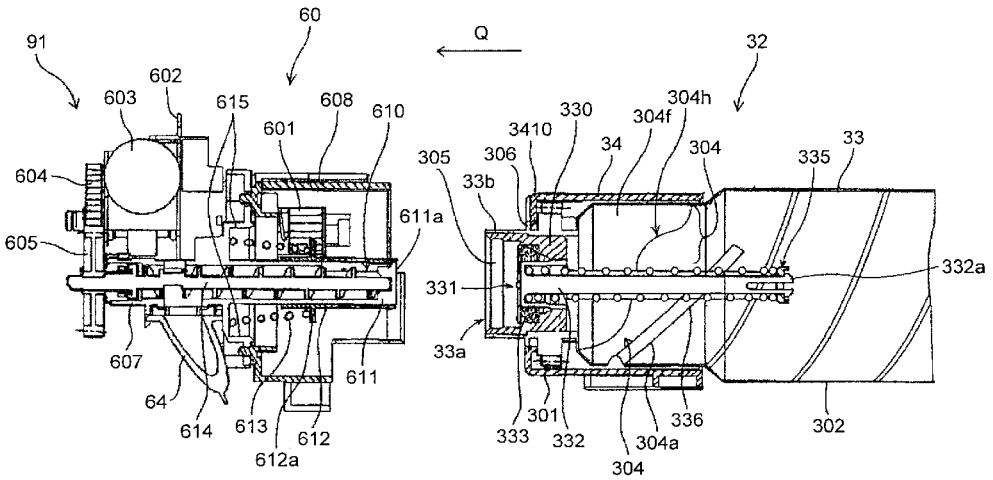


FIG.1

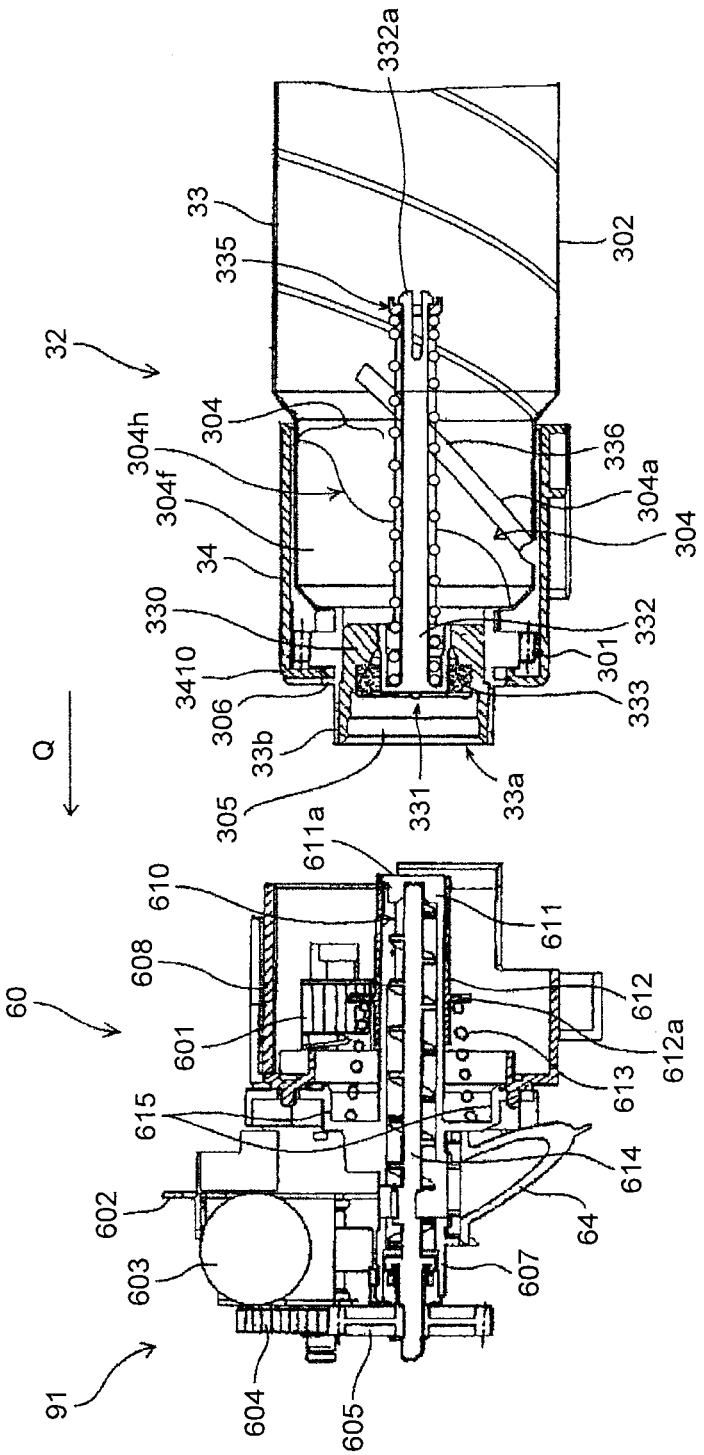

332a
33
335
302
32
304h
304
336
304f
304a
304
34
330
332
301
3410
333
306
33b
305
331
33a
Q
611a
610
611
608
612
60
601
612a
613
615
614
602
64
603
607
91
604
605

FIG.2

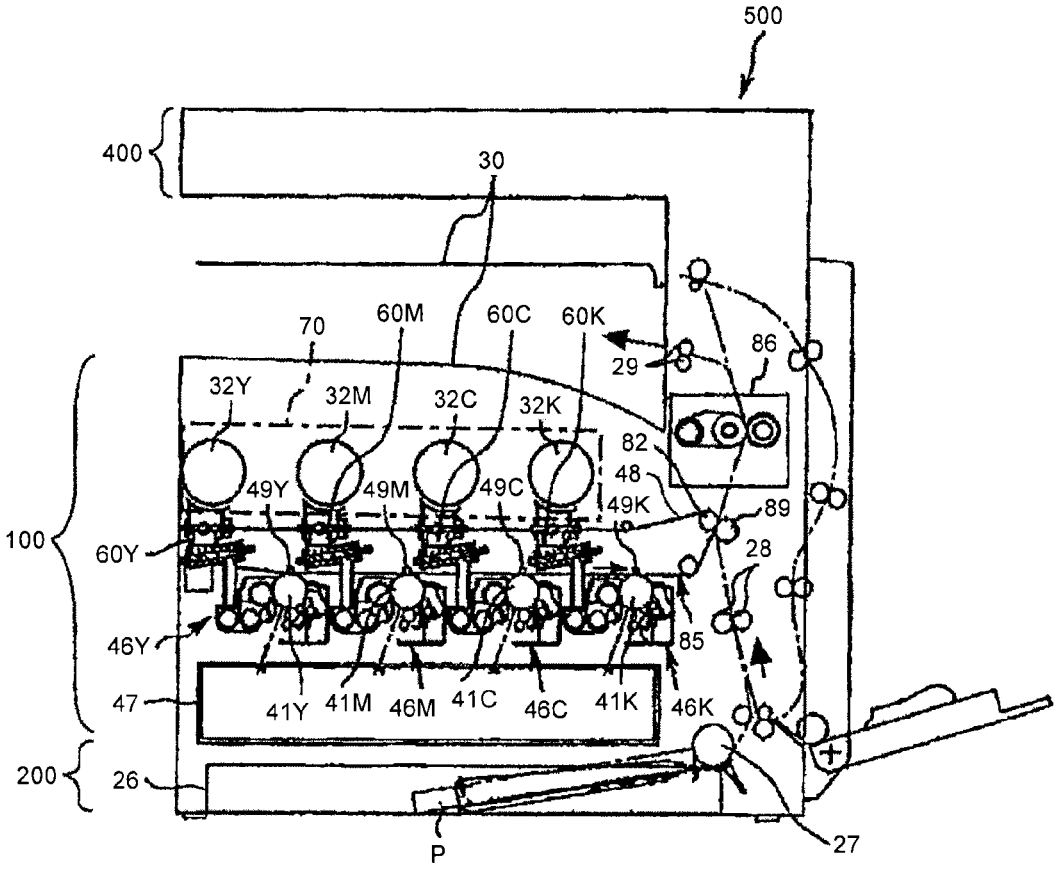

500
400
30
70
60M
60C
60K
29
86
32Y
32M
32C
32K
82
48
49K
89
49Y
49M
49C
100
60Y
28
46Y
85
47
41Y
41M
46M
41C
46C
41K
46K
200
26
P
27

FIG.3

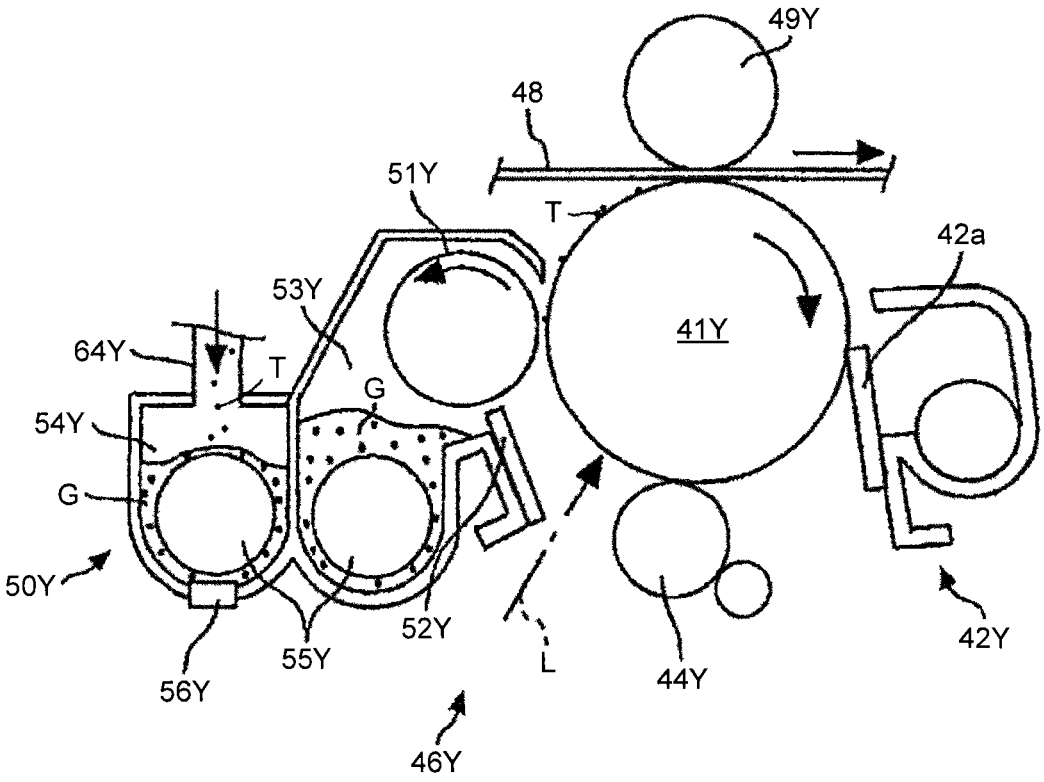


FIG.4

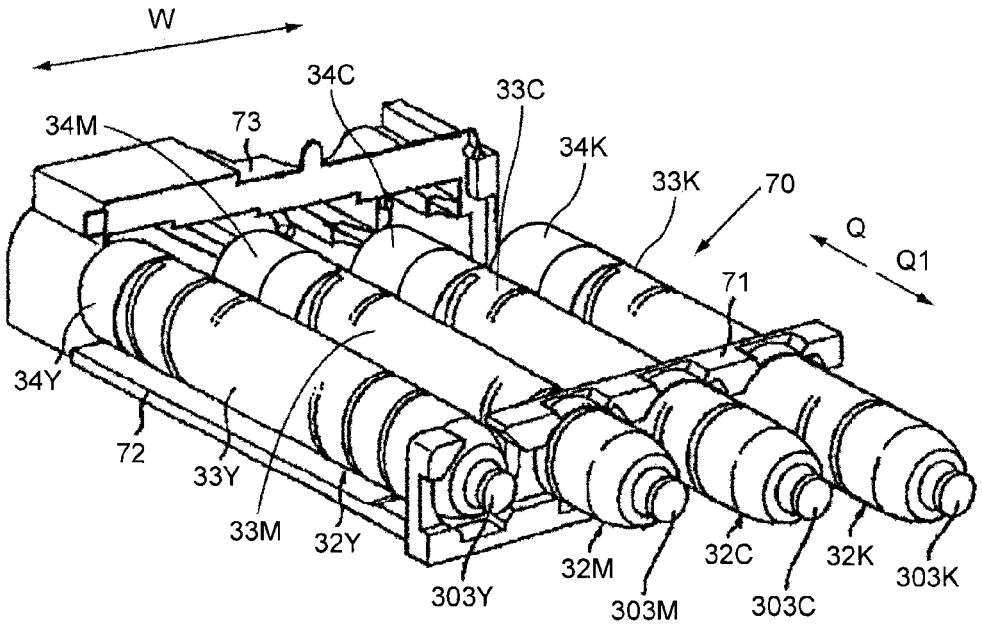

W
34C
33C
34M
73
34K
33K
70
Q
Q1
71
34Y
72
33Y
33M
32Y
303Y
32M
303M
32C
303C
32K
303K

FIG.5

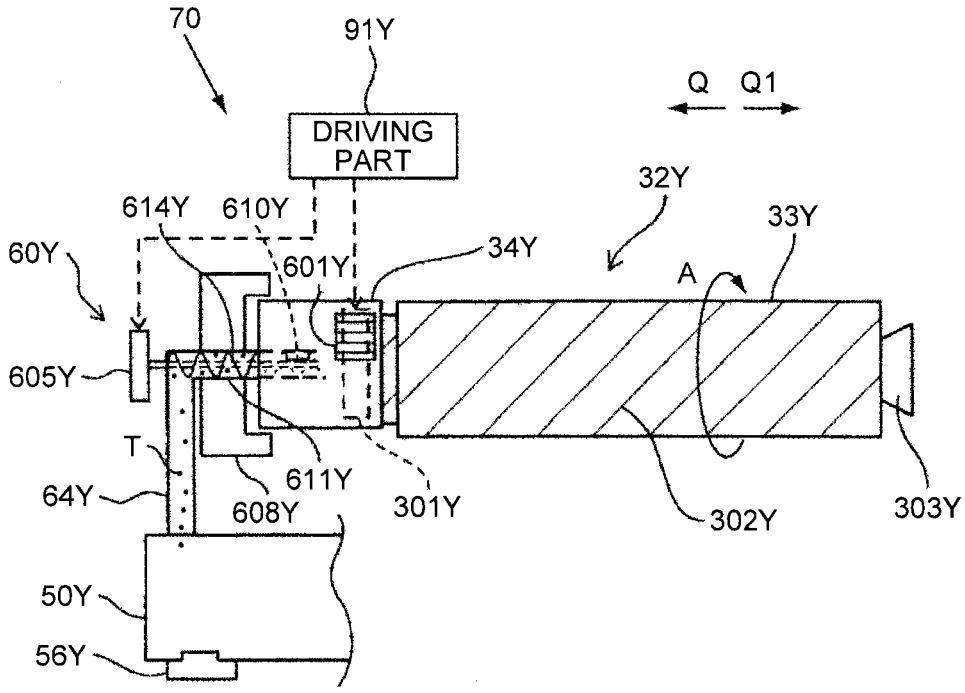

70
91Y
DRIVING PART
Q
Q1
32Y
33Y
614Y
610Y
60Y
601Y
34Y
A
605Y
T
611Y
64Y
608Y
301Y
302Y
303Y
50Y
56Y

FIG.6

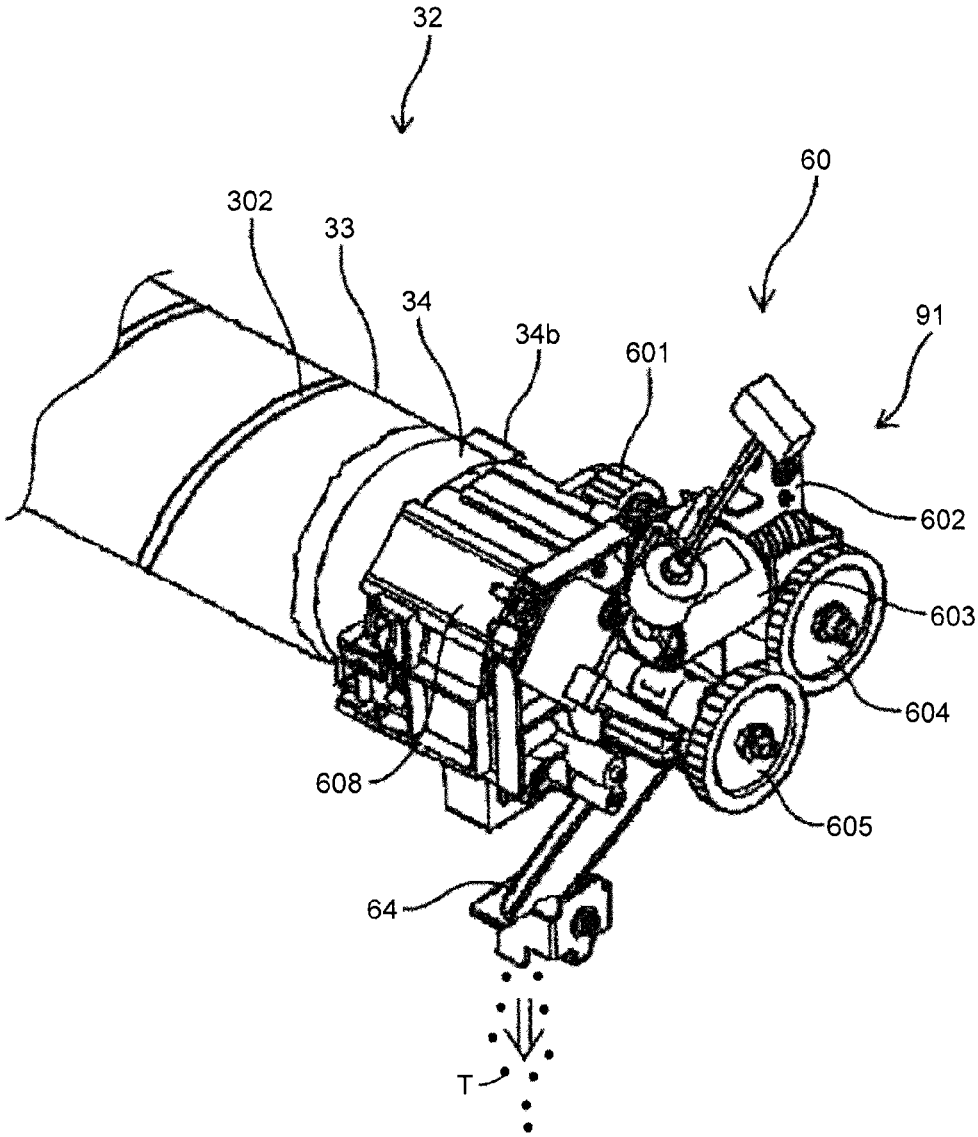


FIG.7

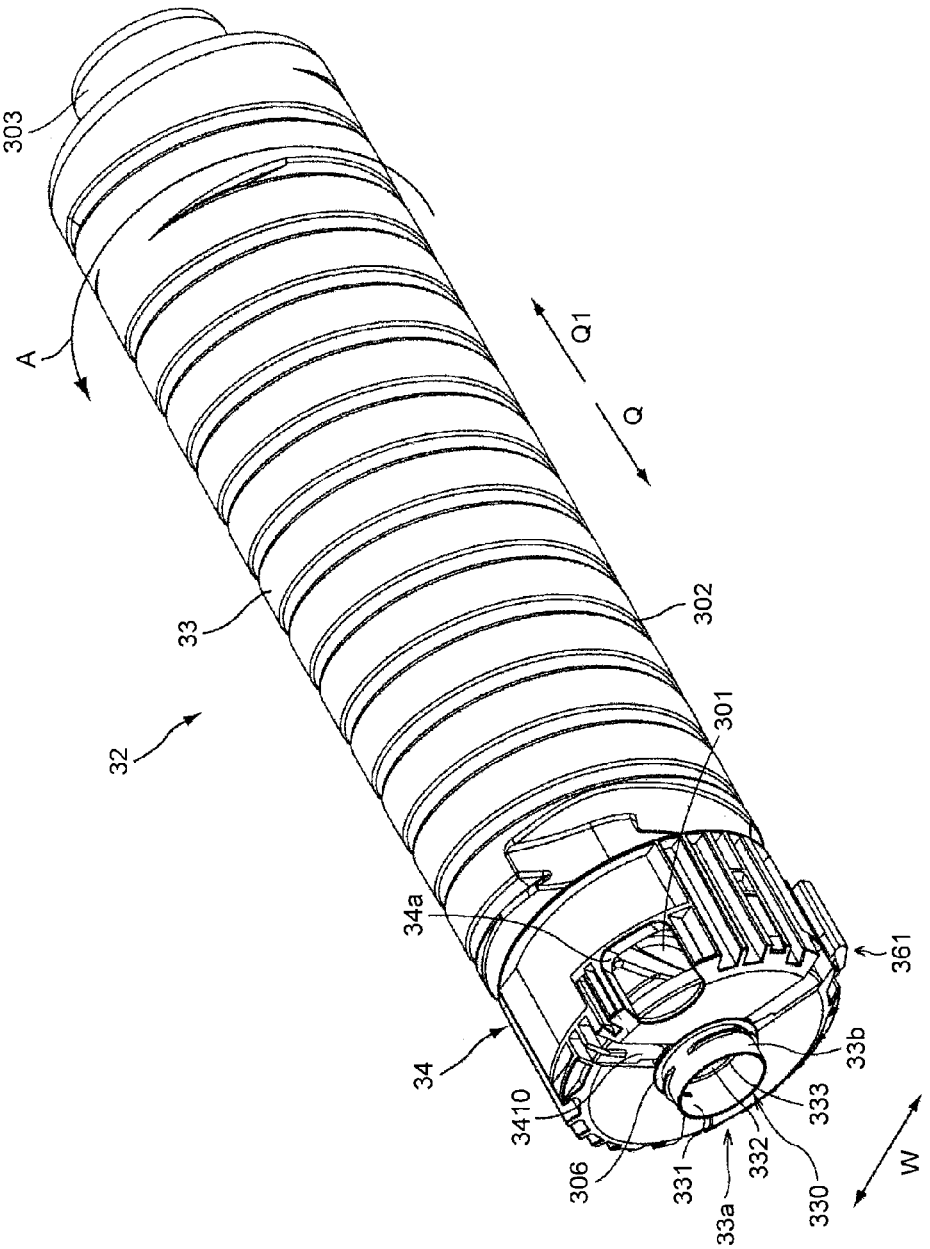

303
A
Q1
Q
33
302
32
301
34a
361
34
33b
3410
333
306
331
332
330
33a
W

FIG.8

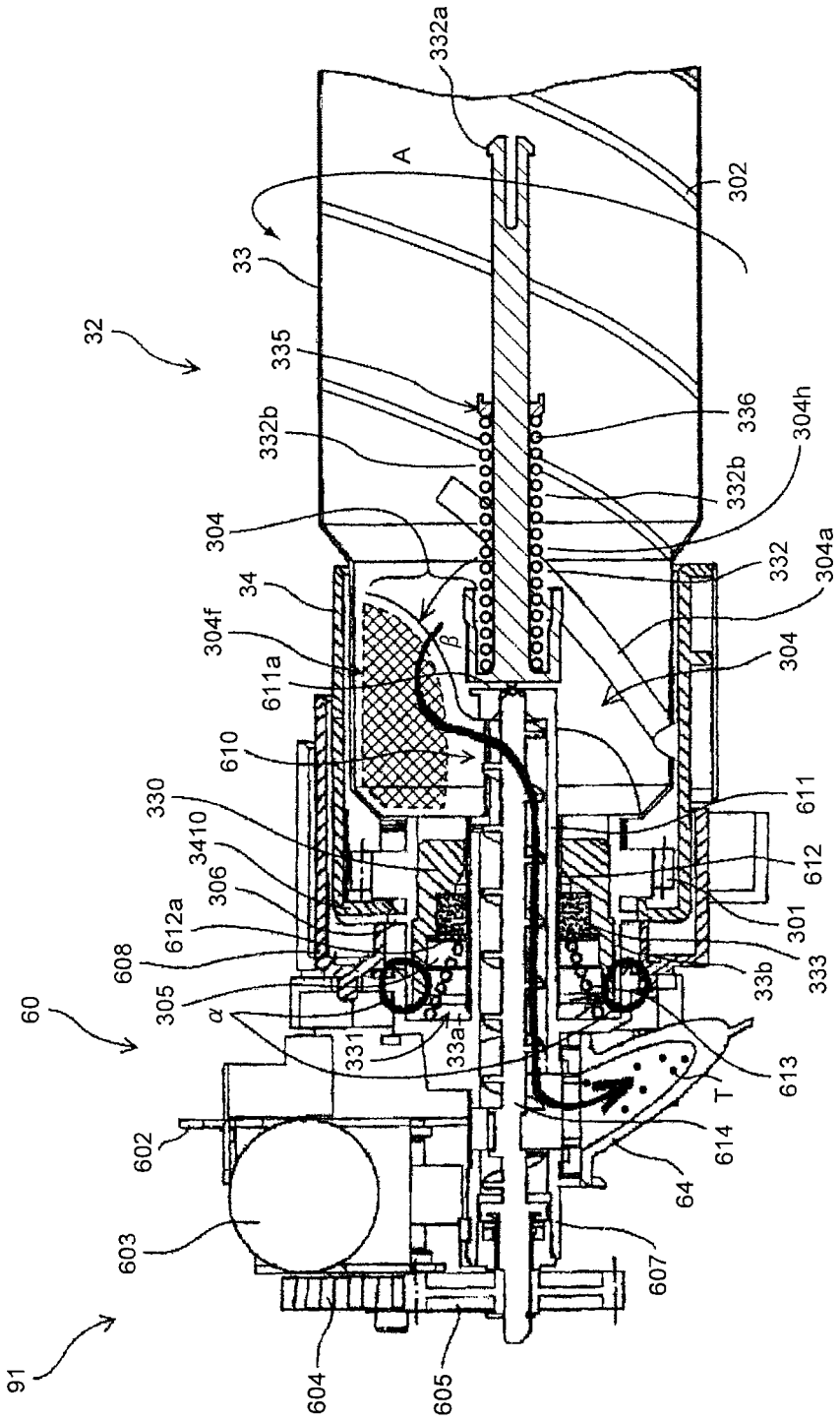

332a
A
302
33
32
335
336
304h
332b
304
332
304a
34
304f
β
304
611a
610
611
330
3410
612
306
612a
301
608
333
305
α
33b
60
331
33at
613
T
602
614
64
603
607
604
605
91

FIG.9

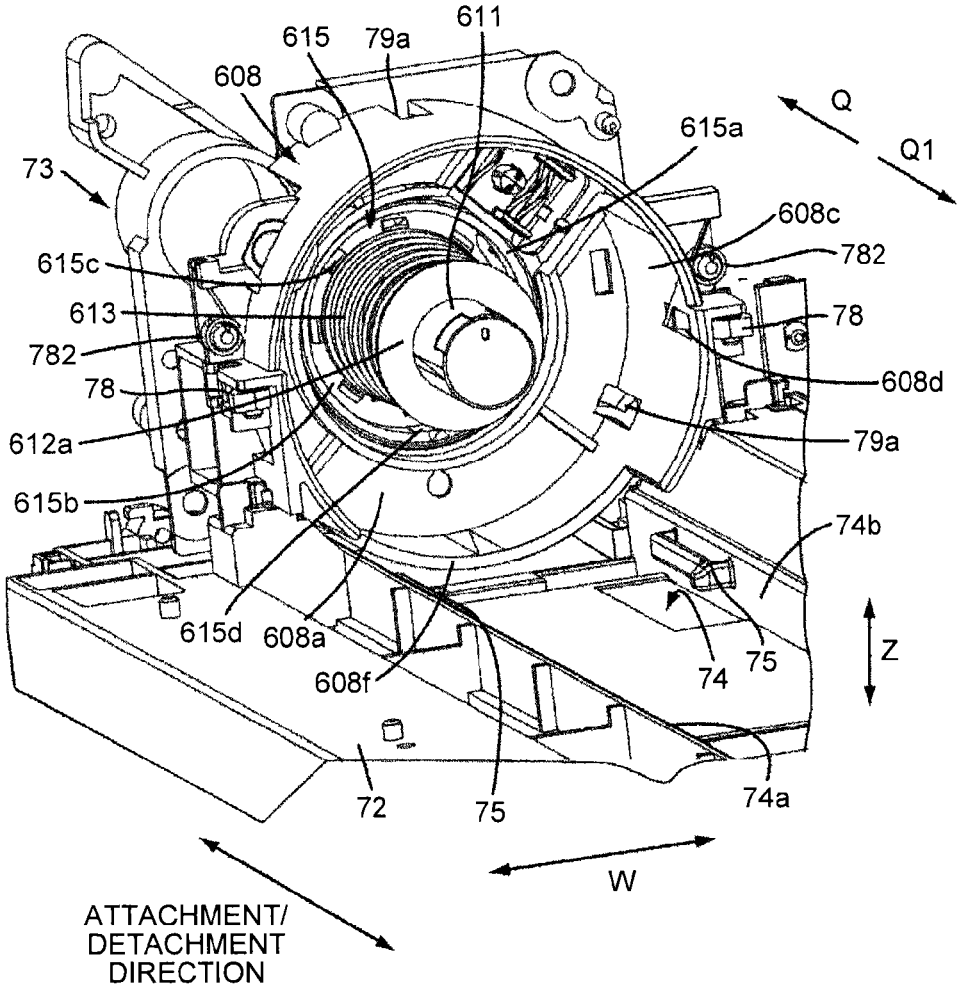

611
615
79a
608
615a
Q
Q1
73
608c
782
615c
613
78
782
608d
78
612a
79a
615b
74b
615d
608a
608f
74
75
Z
72
75
74a
W
ATTACHMENT/
DETACHMENT
DIRECTION

FIG.10

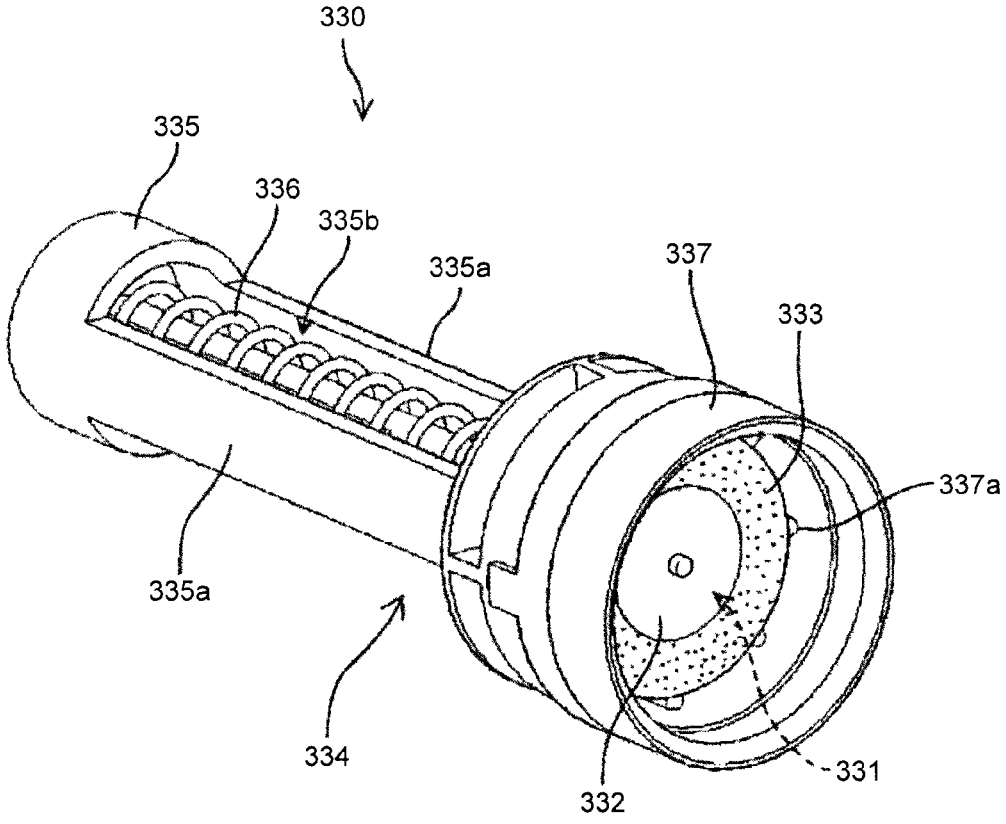


FIG.11A

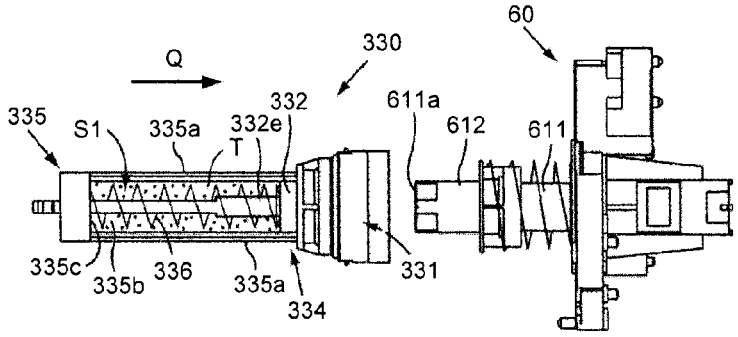


FIG.11B

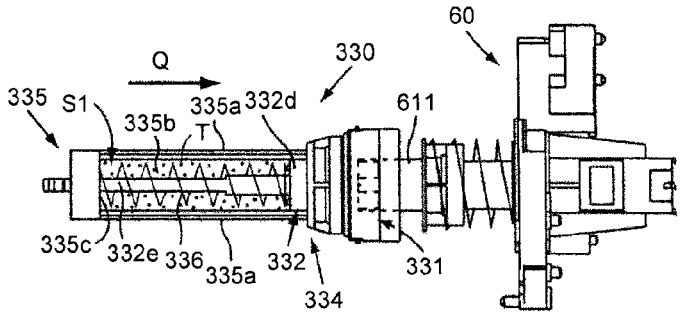


FIG.11C

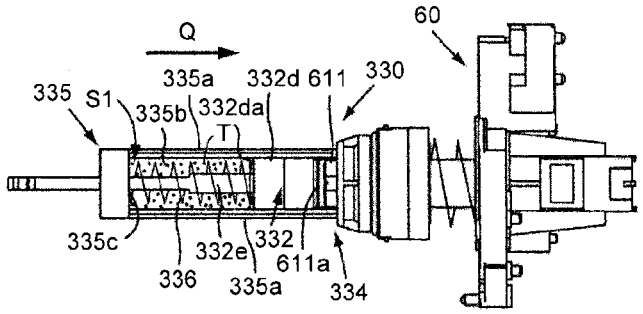


FIG.11D

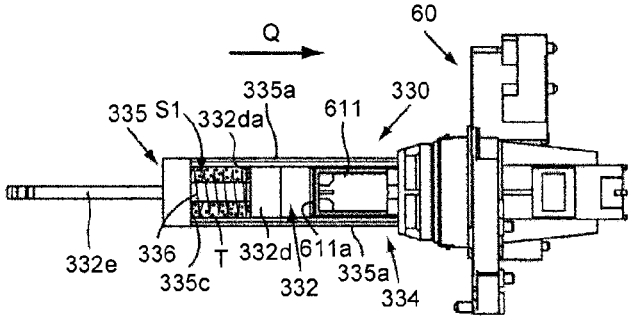


FIG.12A

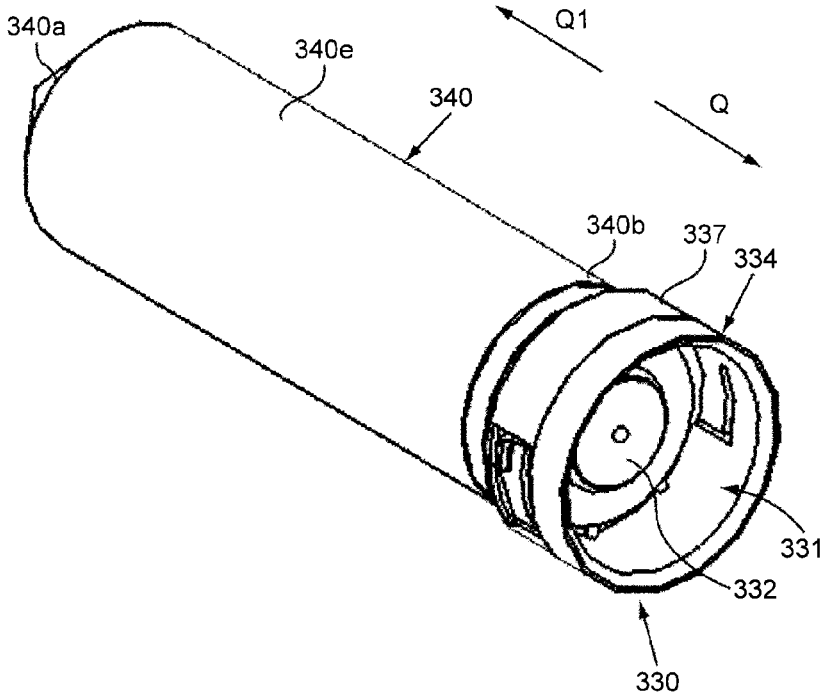


FIG.12B

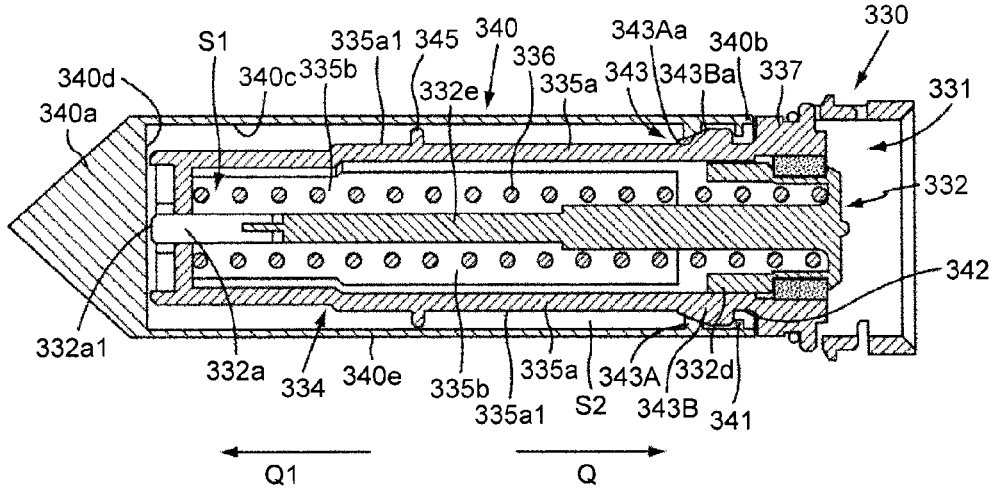


FIG.13A

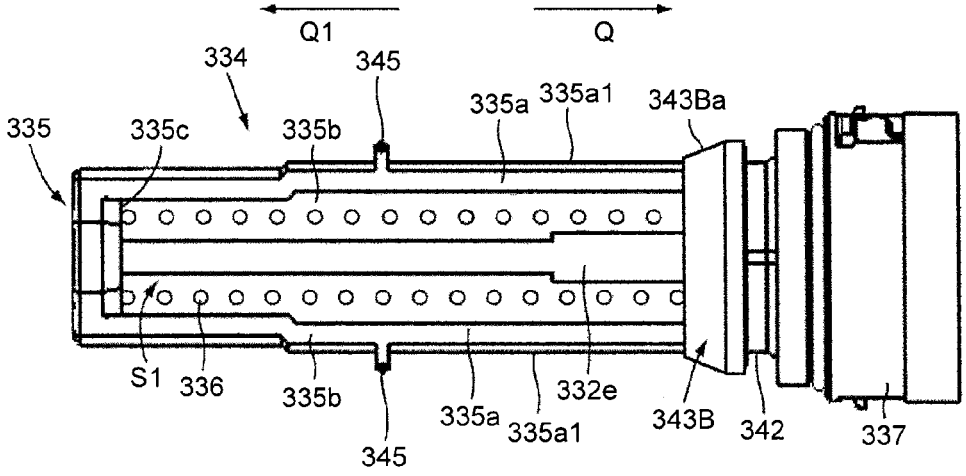


FIG.13B

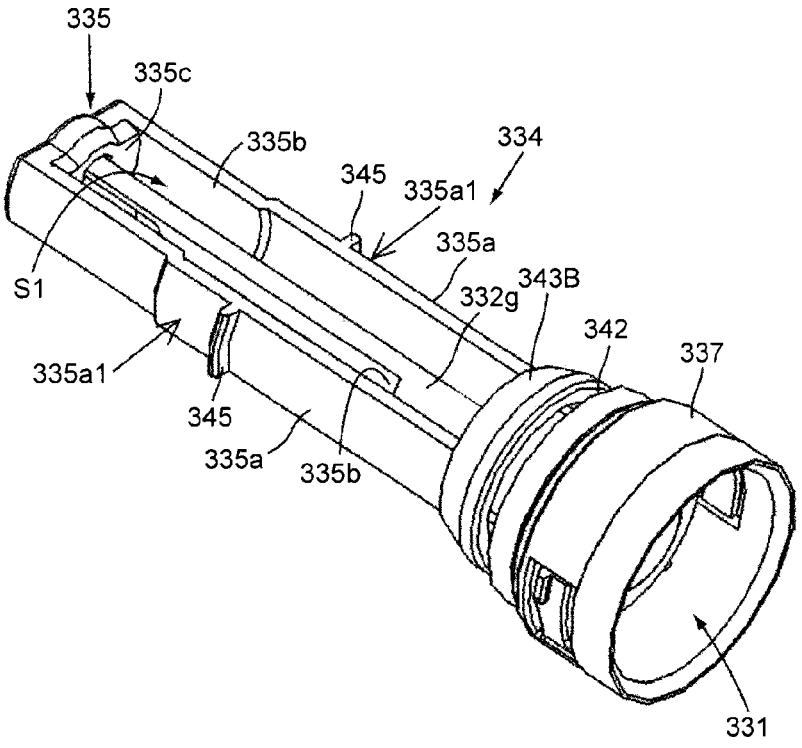


FIG.14A

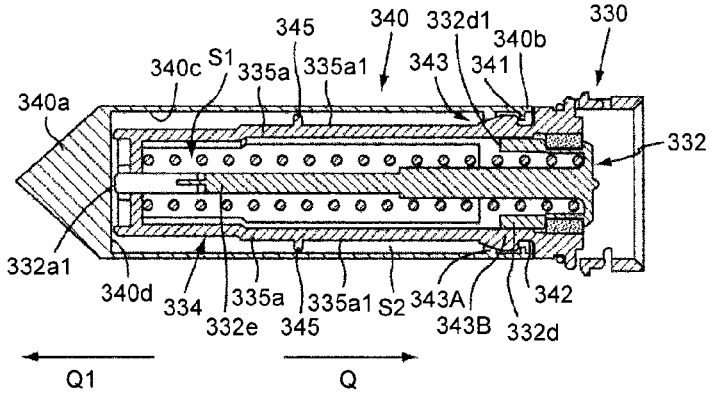


FIG.14B

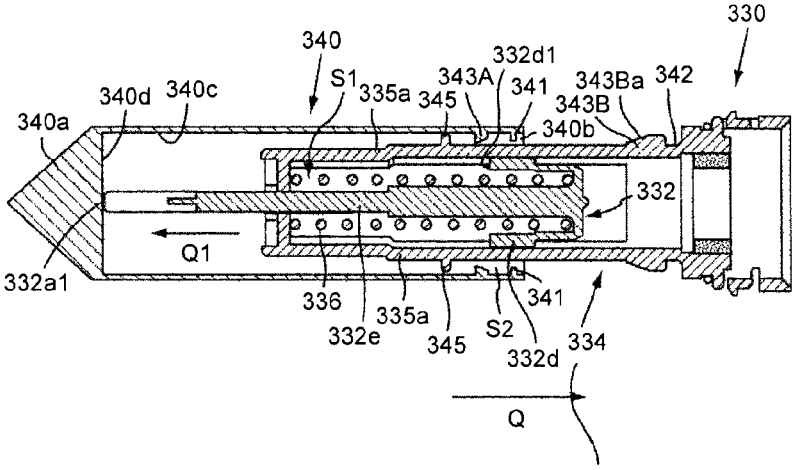


FIG.14C

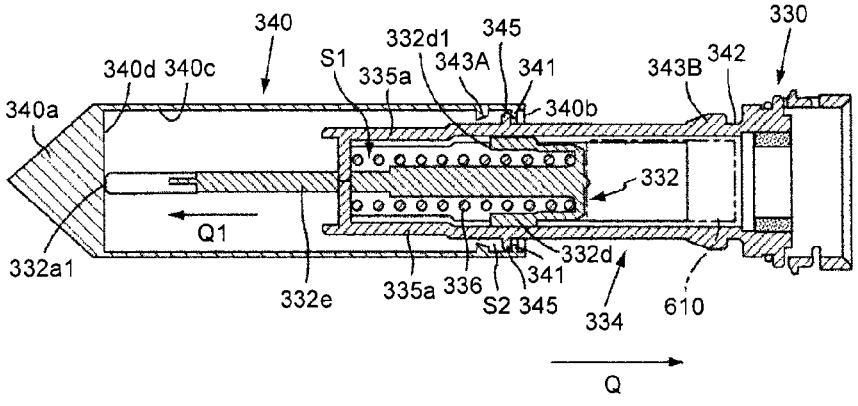


FIG.15

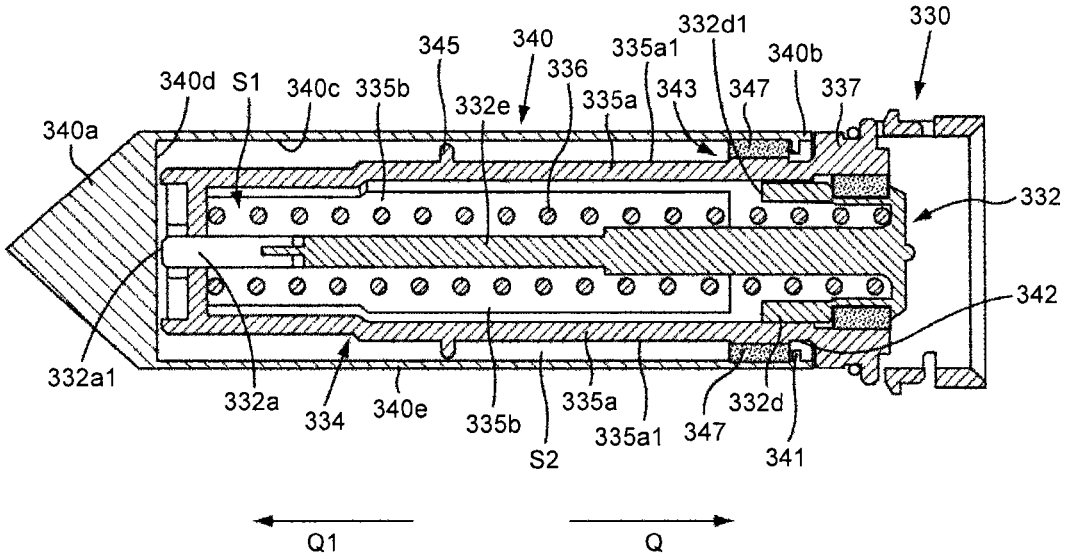

330
332d1
345
340
335a1
340b
340d
S1
340c
335b
336
332e
335a
343
347
337
340a
332
342
332a1
332a
334
340e
335b
335a
335a1
347
332d
341
S2
Q1
Q

FIG.16

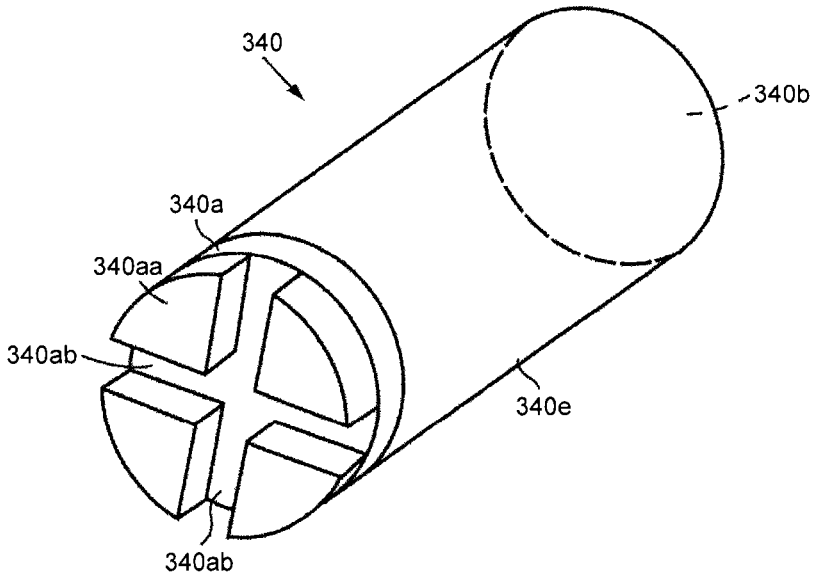

340
340b
340a
340aa
340ab
340e
340ab

FIG.17

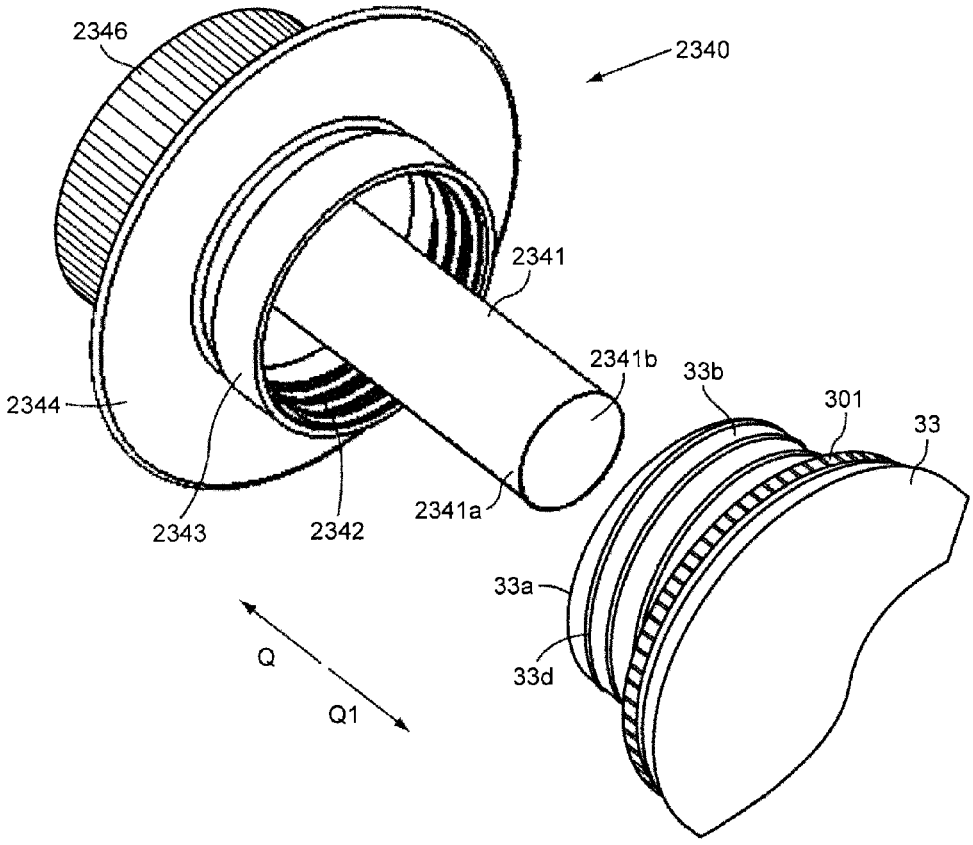

2346
2340
2341
2341b
33b
301
33
2344
2343
2342
2341a
33a
33d
Q
Q1

FIG.18

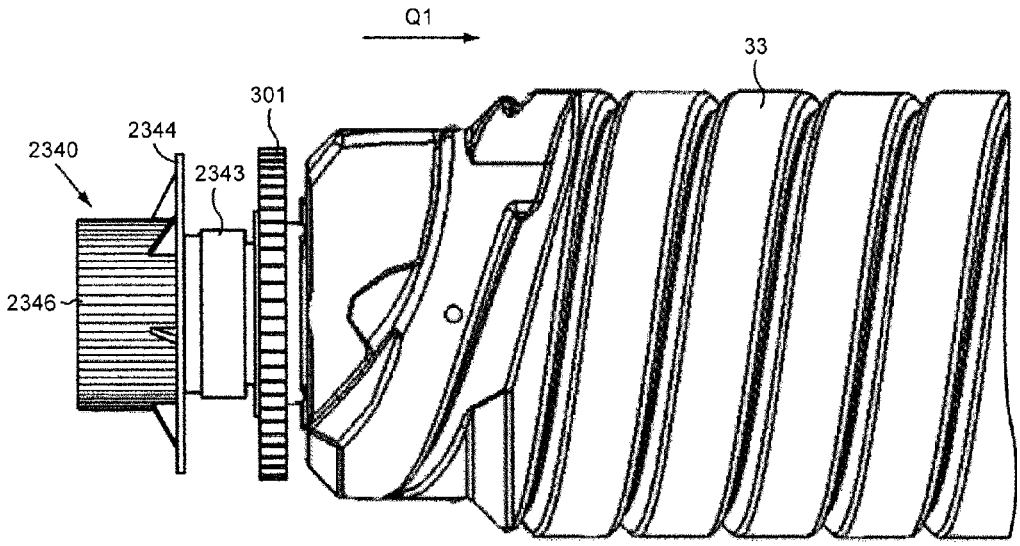

Q1
33
301
2344
2340
2343
2346

FIG.19

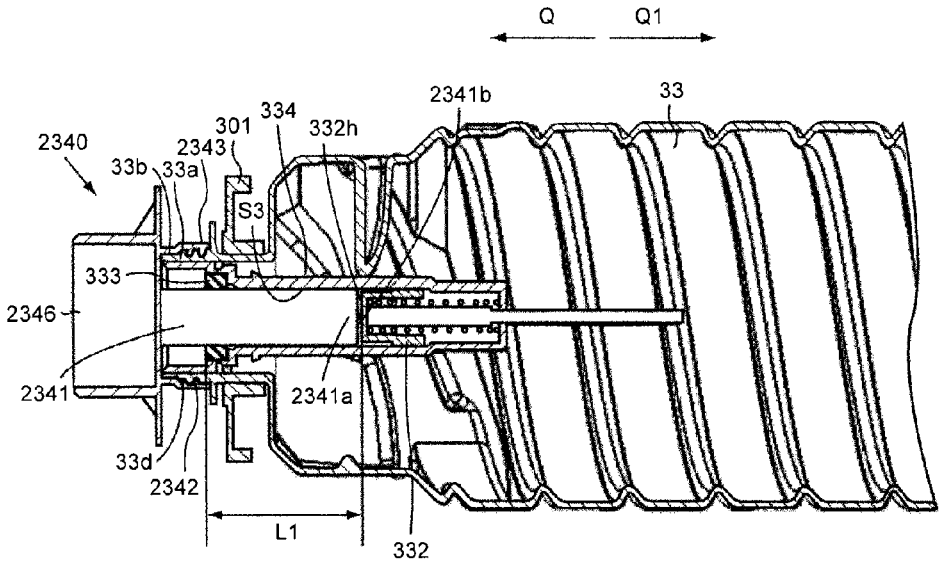

Q
Q1
2341b
33
334
301
332h
2340
2343
33b
33a
S3
333
2346
2341
2341a
33d
2342
L1
332

FIG.20A

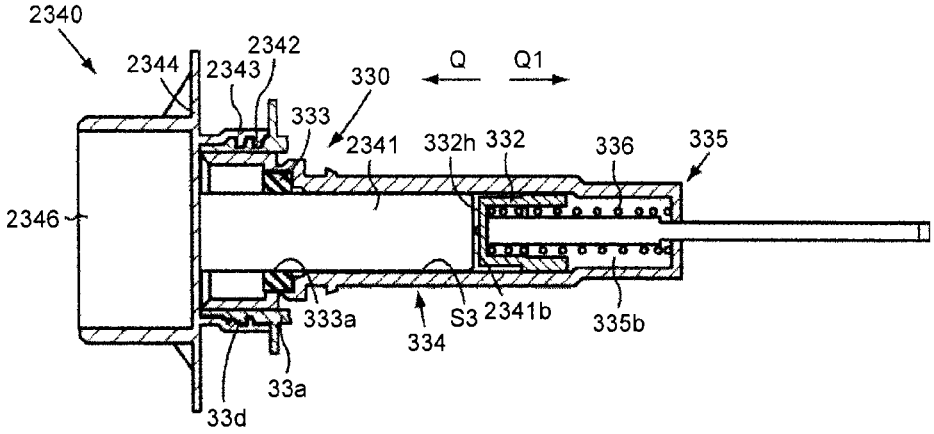


FIG.20B

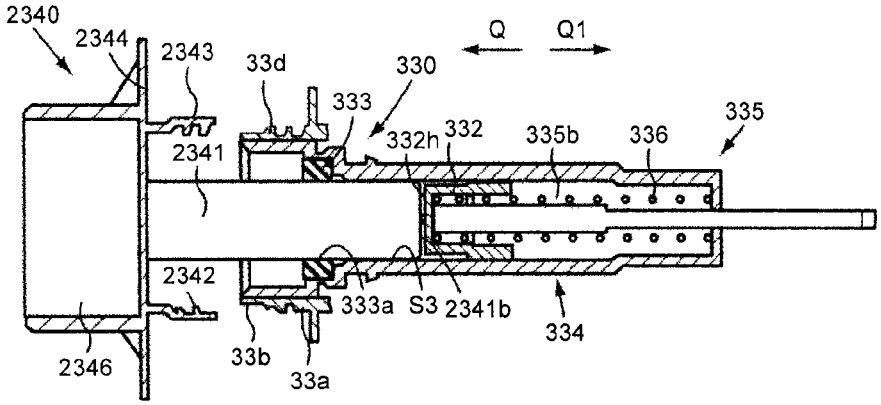


FIG.20C

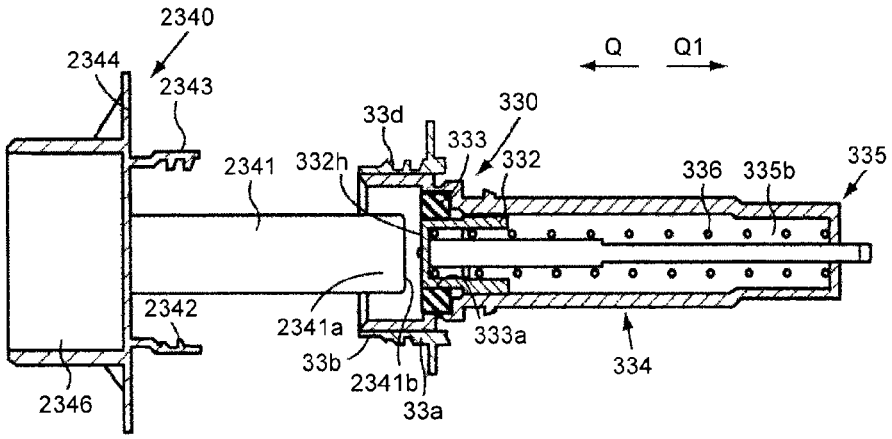


FIG.21A

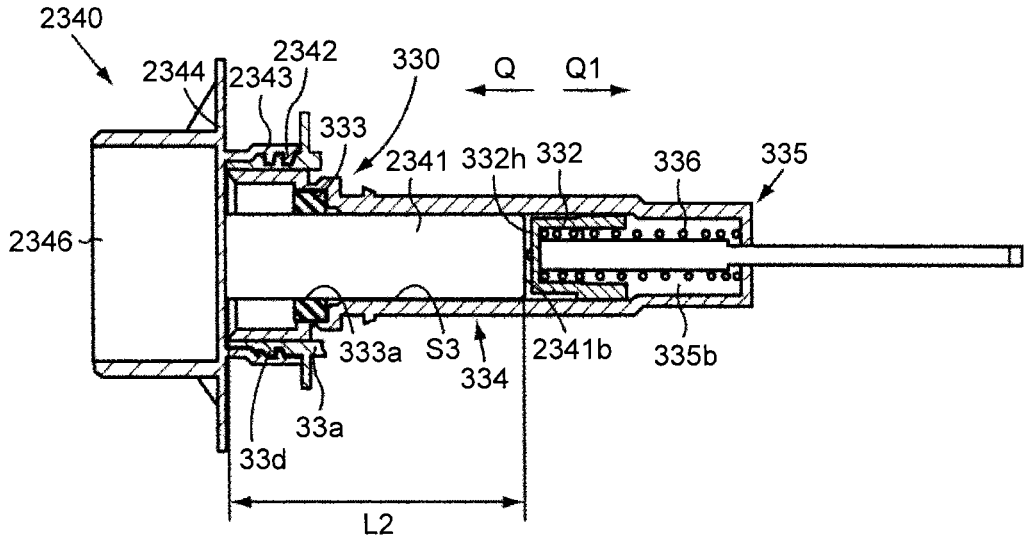


FIG.21B

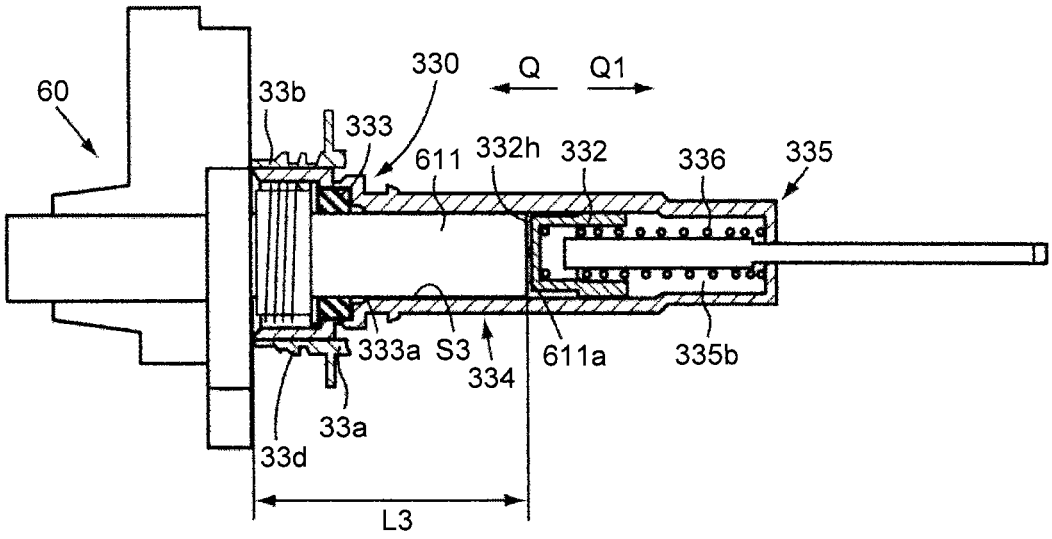


FIG.22

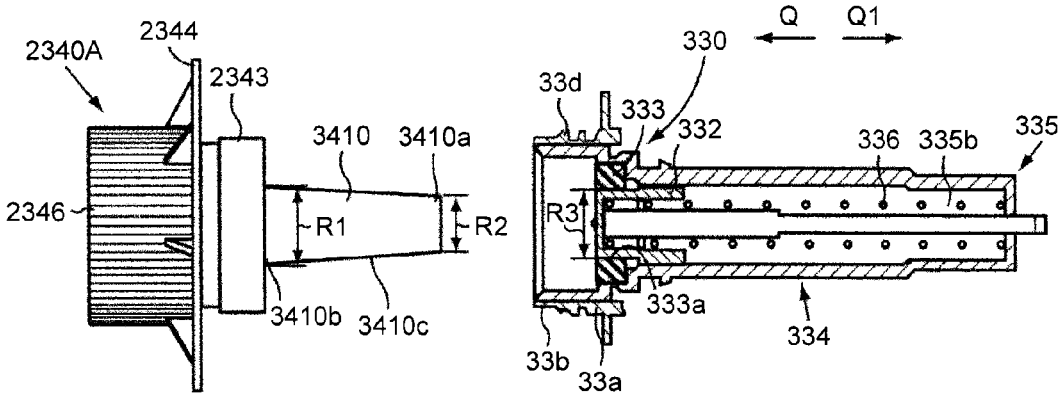
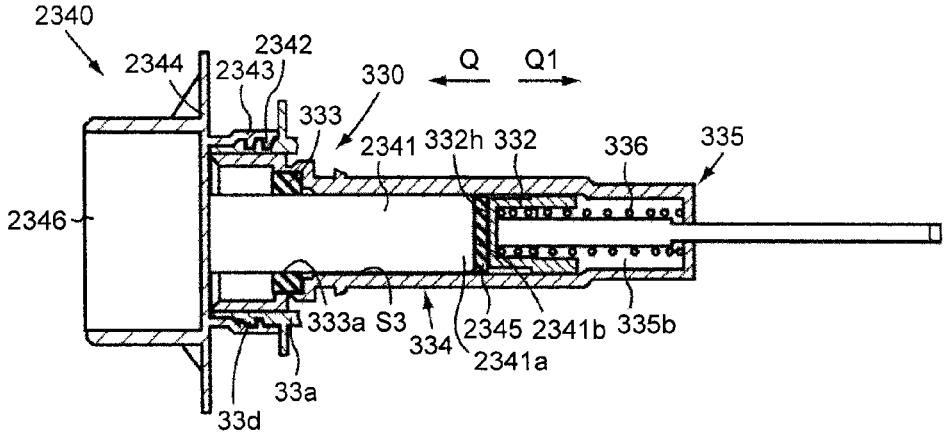

2340A
2344
2343
2346
3410
3410a
R1
R2
3410b
3410c
Q
Q1
330
33d
333
332
336
335b
335
R3
333a
334
33b
33a

FIG.23


2340
2344
2342
2343
330
Q
Q1
333
2341
332h
332
336
335
2346
333a
S3
334
2345
2341b
335b
2341a
33a
33d

NOZZLE RECEIVER, POWDER CONTAINER, AND IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to and incorporates by reference the entire contents of Japanese Patent Application No. 2014-184567 filed in Japan on Sep. 10, 2014 and Japanese Patent Application No. 2015-26838 filed in Japan on Feb. 13, 2015.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a nozzle receiver, a powder container, and an image forming apparatus.

2. Description of the Related Art

In electrophotography image forming apparatuses, such as printers, facsimile machines, copiers, or multifunction peripherals with functions of a printer, a facsimile machine, and a copier, a powder conveying device supplies (replenishes) toner that is developer from a toner container serving as a powder container containing the developer that is powder to a developing device.

A toner container described in Japanese Patent Application Laid-open No. 2012-133349, includes a rotatable cylindrical powder storage, a nozzle receiver attached to the powder storage, an opening arranged on the nozzle receiver, and an opening/closing member that moves to a closing position at which the opening is closed and to an opening position at which the opening is opened along with insertion of the conveying nozzle of the powder replenishing device. When the opening/closing member is moved to the opening position by the conveying nozzle inserted in the toner container along with attachment of the toner container to the powder conveying device, the opening/closing member moves toner located near the opening.

In the configuration as described above, if there is no escape for toner that moves with the movement of the opening/closing member, the toner is compressed and cohered, and prevents the opening/closing member from moving to the closing position when the toner container is detached from the powder container, for example.

It is an object of the present invention to prevent toner from preventing an opening/closing member, which opens and closes an opening arranged on a nozzle receiver of a powder container, from moving to a closing position.

SUMMARY OF THE INVENTION

A nozzle receiver for use with a powder container includes: a shutter to open an opening of the nozzle receiver to an opening position when the shutter is pressed by a conveying nozzle of an image forming apparatus, and to close the opening to a closing position when not being pressed by the conveying nozzle, and that includes a sealing portion for sealing the opening; a supporter to support and guide the shutter between the opening position and the closing position; and a cap to cover the supporter when the shutter is located at the closing position.

The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an explanatory cross-sectional view of a powder conveying device before a powder container according to embodiments of the present invention is attached and the powder container;

FIG. **2** is an overall configuration diagram of an image forming apparatus according to the embodiments;

FIG. **3** is a schematic diagram illustrating a configuration of an image forming section of the image forming apparatus illustrated in FIG. **2**;

FIG. **4** is a schematic perspective view illustrating a state in which the powder containers are attached to a container holding section;

FIG. **5** is a schematic diagram illustrating a state in which the powder container is attached to the powder conveying device of the image forming apparatus illustrated in FIG. **2**;

FIG. **6** is an explanatory perspective view of the powder conveying device to which the powder container is attached and the powder container;

FIG. **7** is an explanatory perspective view illustrating a configuration of the powder container according to the embodiments;

FIG. **8** is an explanatory cross-sectional view of the powder conveying device to which the powder container is attached and the powder container;

FIG. **9** is an explanatory partially-enlarged perspective view of the container holding section according to the embodiments;

FIG. **10** is an explanatory perspective view illustrating a configuration of a nozzle insertion member;

FIGS. **11**A to **11**D are top plan views for explaining states of the opening/closing member and a conveying nozzle in attachment operation;

FIG. **12**A is an explanatory perspective view illustrating a configuration of the nozzle insertion member including an inner cap according to a first embodiment, when viewed from a nozzle insertion side;

FIG. **12**B is an explanatory cross-sectional view of the nozzle insertion member including the inner cap according to the first embodiment;

FIG. **13**A is a side view for explaining a configuration of a container shutter supporter to which the inner cap is to be attached;

FIG. **13**B is a perspective view of the container shutter supporter when viewed from the nozzle insertion side;

FIG. **14**A is a diagram for explaining operation of the opening/closing member and the inner cap at the time of attachment of the powder container, and illustrating a state in which the inner cap is located at a closure position;

FIG. **14**B is a diagram illustrating a state in which the inner cap is moving from the closure position to a release position;

FIG. **14**C is a diagram illustrating a state in which the inner cap is located at the release position;

FIG. **15** is an explanatory cross-sectional view of another example of a sealing portion in the nozzle insertion member including the inner cap according to the first embodiment;

FIG. **16** is a perspective view for explaining another example of the inner cap according to the first embodiment;

FIG. **17** is an enlarged perspective view for explaining a configuration of a cap (outer cap) according to a second embodiment;

FIG. **18** is an external view for explaining an attachment state of the cap according to the second embodiment;

FIG. **19** is a cross-sectional view for explaining the attachment state of the cap according to the second embodiment;

FIGS. **20**A to **20**C are top plan views of the cap in detachment operation;

FIG. **21**A is a diagram for explaining a relationship between the length of an insertion part and the length of a nozzle insertion opening;

FIG. **21**B is a diagram for explaining a relationship between the length of a conveying nozzle and the length of the nozzle insertion opening;

FIG. **22** is a cross-sectional view for explaining another example of the cap according to the second embodiment; and

FIG. **23** is a cross-sectional view for explaining a still another example of the cap according to the second.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

Embodiments of the present invention will be described below with reference to the accompanying drawings. In the descriptions of the embodiments and conventional configurations, the same components or components with the same functions are basically denoted by the same reference symbols, and detailed explanation thereof will be omitted. The descriptions below are mere examples and do not limit the scope of the appended claims. Further, a person skilled in the art may easily conceive other embodiments by making modifications or changes within the scope of the appended claims; however, such modifications and changes obviously fall within the scope of the appended claims. In the drawings, Y, M, C, and K are symbols appended to components corresponding to yellow, magenta, cyan, and black, respectively, and will be omitted appropriately.

FIG. **2** is an overall configuration diagram of an electrophotography tandem-type color copier (hereinafter, referred to as "a copier **500**") serving as an image forming apparatus according to an embodiment. The copier **500** may be a monochrome copier. The image forming apparatus may be a printer, a facsimile machine, or a multifunction peripheral with at least two of the functions of a copier, a printer, a facsimile machine, and a scanner, instead of the copier. The copier **500** mainly includes a copier main-body (hereinafter, referred to as "a printer **100**"), a sheet feed table (hereinafter, referred to as "a sheet feeder **200**"), and a scanner section (hereinafter, referred to as "a scanner **400**") mounted on the printer **100**.

Four toner containers **32**Y, **32**M, **32**C, **32**K serving as powder containers corresponding to different colors (yellow, magenta, cyan, black) are detachably (replaceably) attached to a toner container holder **70** serving as a container holding section provided in the upper part of the printer **100**.

An intermediate transfer device **85** is arranged below the toner container holder **70**. The intermediate transfer device **85** includes an intermediate transfer belt **48** serving as an intermediate transfer medium, four primary-transfer bias rollers **49**Y, **49**M, **49**C, **49**K, a secondary-transfer backup roller **82**, multiple rollers, an intermediate-transfer cleaning device, and the like. The intermediate transfer belt **48** is stretched and supported by multiple rollers and endlessly moves counterclockwise in FIG. **2** along with rotation of the secondary-transfer backup roller **82** serving as one of the rollers.

In the printer **100**, four image forming sections **46**Y, **46**M, **46**C, **46**K corresponding to the respective colors are arranged in tandem so as to face the intermediate transfer belt **48**. Four toner replenishing devices **60**Y, **60**M, **60**C, **60**K serving as powder replenishing (supply) devices corresponding to the four toner containers **32**Y, **32**M, **32**C, **32**K of the four colors are arranged below the toner containers **32**Y, **32**M, **32**C, **32**K, respectively. The toner replenishing devices **60**Y, **60**M, **60**C, **60**K respectively supply (replenish) toner T (see FIG. **3**) that is powder developer contained in the toner containers **32**Y, **32**M, **32**C, **32**K to developing devices of the image forming sections **46**Y, **46**M, **460**, **46**K for the respective colors. In the embodiment, the four image forming sections **46**Y, **46**M, **46**C, **46**K form an image forming unit.

As illustrated in FIG. **2**, the printer **100** includes an exposing device **47** serving as a latent-image forming means below the four image forming sections **46**Y, **46**M, **46**C, **46**K. The exposing device **47** exposes and scans the surfaces of photoconductors **41**Y, **41**M, **41**C, **41**K serving as image bearers (to be described later) with light based on image information of an original image read by the scanner **400**, so that electrostatic latent images are formed on the surfaces of the photoconductors. The image information may be input from an external apparatus, such as a personal computer, connected to the copier **500**, instead of being read by the scanner **400**.

In the embodiment, a laser beam scanning system using a laser diode is employed as the exposing device **47**. However, other configurations, such as a configuration including an LED array, may be employed as the exposing means.

FIG. **3** is a schematic diagram illustrating an overall configuration of the image forming section **46**Y corresponding to yellow.

The image forming section **46**Y includes the drum-shaped photoconductor **41**Y. The image forming section **46**Y includes a charging roller **44**Y serving as a charging device, a developing device **50**Y serving as a developing means, a cleaning device **42**Y to clean the photoconductor, a neutralizing device, and the like, all of which are arranged around the photoconductor **41**Y. Image forming processes (a charging process, an exposing process, a developing process, a transfer process, and a cleaning process) are performed on the photoconductor **41**Y, so that a yellow toner image is formed on the photoconductor **41**Y.

The other three image forming sections **46**M, **46**C, **46**K have almost the same configurations as the image forming section **46**Y for yellow except that colors of toner T to be used are different and toner images corresponding to the respective colors of the toner T are formed on the photoconductors **41**M, **41**C, **41**K. Hereinafter, explanation of only the image forming section **46**Y for yellow will be given, and explanation of the other three image forming sections **46**M, **46**C, **46**K will be omitted appropriately.

The photoconductor **41**Y is rotated clockwise in FIG. **3** by a driving motor. The surface of the photoconductor **41**Y is uniformly charged at a position facing the charging roller **44**Y (charging process). Subsequently, the surface of the photoconductor **41**Y reaches a position of irradiation with laser light L emitted by the exposing device **47**, where an electrostatic latent image for yellow is formed through exposure scanning (exposing process). The surface of the photoconductor **41**Y then reaches a position facing the

developing device **50**Y, where the electrostatic latent image is developed with yellow toner T to form a yellow toner image (developing device).

The primary-transfer bias roller **49**Y of the intermediate transfer device **85** and the photoconductor **41**Y sandwich the intermediate transfer belt **48**, so that a primary transfer nip for yellow is formed. A transfer bias with polarity opposite to the polarity of the toner T is applied to the primary-transfer bias roller **49**Y.

The surface of the photoconductor **41**Y, on which the toner image is formed through the developing process, reaches the primary transfer nip facing the primary-transfer bias roller **49**Y across the intermediate transfer belt **48**, and the toner image on the photoconductor **41**Y is transferred to the intermediate transfer belt **48** at the primary transfer nip (primary transfer process). At this time, a slight amount of non-transferred toner remains on the photoconductor **41**Y. The surface of the photoconductor **41**Y, from which the toner image has been transferred to the intermediate transfer belt **48** at the primary transfer nip, reaches a position facing the cleaning device **42**Y. At this position, the non-transferred toner remaining on the photoconductor **41**Y is mechanically collected by a cleaning blade **42***a* included in the cleaning device **42**Y (cleaning process). The surface of the photoconductor **41**Y finally reaches a position facing the neutralizing device, where the residual potential on the photoconductor **41**Y is removed. In this way, a series of the image forming processes performed on the photoconductor **41**Y is completed.

The above-described image forming processes are also performed on the other image forming sections **46**M, **46**C, **46**K in the same manner as the image forming section **46**Y for yellow. Specifically, the exposing device **47** arranged below the image forming sections **46**M, **46**C, **46**K emits laser light L based on the image information toward the photoconductors **41**M, **41**C, **41**K of the image forming sections **46**M, **46**C, **46**K. More specifically, the exposing device **47** emits the laser light L from a light source and irradiates each of the photoconductors **41**M, **41**C, **41**K with the laser light L via multiple optical elements while performing scanning with the laser light L by a rotating polygon mirror.

Subsequently, toner images of the respective colors formed on the photoconductors **41**M, **41**C, **41**K through the developing process are transferred to the intermediate transfer belt **48** due to the action of transfer biases applied to the respective primary-transfer bias rollers at the four-color primary-transfer nips that are formed by sandwiching the intermediate transfer belt **48** between the primary-transfer bias rollers **49**M, **49**C, **49**K and the photoconductors **41**M, **41**C, **41**K.

At this time, the intermediate transfer belt **48** moves counterclockwise in FIG. **2** and sequentially passes through the primary transfer nips of the primary-transfer bias rollers **49**Y, **49**M, **49**C, **49**K. Therefore, the toner images of the respective colors on the photoconductors **41**Y, **41**M, **41**C, **41**K are primarily transferred to the intermediate transfer belt **48** in a superimposed manner, so that a color toner image is formed on the intermediate transfer belt **48**.

The intermediate transfer belt **48**, on which the color toner image is formed by the superimposed toner images of the respective colors, reaches a position facing a secondary-transfer roller **89**. At this position, the secondary-transfer backup roller **82** and the secondary transfer roller **89** sandwich the intermediate transfer belt **48**, so that a secondary transfer nip is formed. The color toner image formed on the intermediate transfer belt **48** is transferred to a recording medium P, such as a sheet of paper, conveyed to the position of the secondary transfer nip, due to the action of a transfer bias applied to the secondary-transfer backup roller **82**, for example. At this time, non-transferred toner which has not been transferred to the recording medium P remains on the intermediate transfer belt **48**. The intermediate transfer belt **48** that has passed through the secondary transfer nip reaches the position of the intermediate-transfer cleaning device, where the non-transferred toner remaining on the surface is collected. In this way, a series of transfer processes performed on the intermediate transfer belt **48** is completed.

Movement of the recording medium P will be explained below with reference to FIG. **2**.

The recording medium P is conveyed to the secondary transfer nip from a feed tray **26** provided in the sheet feeder **200** arranged below the printer **100** via a feed roller **27**, a registration roller pair **28**, and the like. Specifically, multiple recording media P are stacked in the feed tray **26**. When the feed roller **27** is rotated counterclockwise in FIG. **2**, the topmost recording medium P is fed to a nip between two rollers of the registration roller pair **28**.

The recording medium P conveyed to the registration roller pair **28** temporarily stops at the position of the nip between the rollers of the registration roller pair **28**, the rotation of which is being stopped. The registration roller pair **28** is rotated to convey the recording medium P toward the secondary transfer nip in accordance with the timing at which the color toner image on the intermediate transfer belt **48** reaches the secondary transfer nip. Accordingly, a desired color image is formed on the recording medium P.

The recording medium P on which the color toner image is transferred at the secondary transfer nip is conveyed to the position of a fixing device **86**. In the fixing device **86**, the color toner image transferred on the surface of the recording medium P is fixed to the recording medium P by heat and pressure applied by a fixing belt and a pressing roller. The recording medium P that has passed through the fixing device **86** is discharged to the outside of the apparatus via a nip between rollers of a discharge roller pair **29**. The recording medium P discharged to the outside of the apparatus by the discharge roller pair **29** is sequentially stacked, as an output image, on a stack section **30**. In this way, a series of image forming processes in the copier **500** is completed.

A configuration and operation of the developing device **50** in the image forming section **46** will be explained in detail below. In the following, the image forming section **46**Y for yellow will be explained by way of example. However, the image forming sections **46**M, **46**C, **46**K for the other colors have the same configurations and perform the same operation.

As illustrated in FIG. **3**, the developing device **50**Y includes a developing roller **51**Y serving as a developer bearer, a doctor blade **52**Y serving as a developer regulating plate, two developer conveying screws **55**Y, a toner density sensor **56**Y, and the like. The developing roller **51**Y faces the photoconductor **41**Y. The doctor blade **52**Y faces the developing roller **51**Y. The two developer conveying screws **55**Y are arranged inside two developer accommodating sections, i.e., first and second developer accommodating sections **53**Y and **54**Y. The developing roller **51**Y includes a magnet roller disposed inside thereof, a sleeve that rotates around the magnet roller, and the like. Two-component developer G containing carrier and toner is stored in the first developer accommodating section **53**Y and the second developer accommodating section **54**Y. The second developer accommodating section **54**Y communicates with a toner dropping

passage **64**Y via an opening provided in the upper side thereof. The toner density sensor **56**Y detects a toner density in the developer G stored in the second developer accommodating section **54**Y.

The developer G in the developing device **50** circulates between the first developer accommodating section **53**Y and the second developer accommodating section **54**Y while being stirred by the two developer conveying screws **55**Y. The developer G in the first developer accommodating section **53**Y is supplied to and borne on the surface of the sleeve of the developing roller **51**Y due to a magnetic field generated by the magnet roller in the developing roller **51**Y while the developer G is being conveyed by one of the developer conveying screws **55**Y. The sleeve of the developing roller **51**Y rotates counterclockwise as indicated by an arrow in FIG. **3**, and the developer G borne on the developing roller **51**Y moves on the developing roller **51**Y along with the rotation of the sleeve. At this time, the toner in the developer G electrostatically adheres to the carrier by being charged to the potential opposite to the polarity of the carrier due to triboelectric charging with the carrier in the developer G, and is borne on the developing roller **51**Y together with the carrier that is attracted by the magnetic field generated on the developing roller **51**Y.

The developer G borne on the developing roller **51**Y is conveyed in the direction of the arrow in FIG. **3** and reaches a doctor section where the doctor blade **52**Y and the developing roller **51**Y face each other. The amount of the developer G on the developing roller **51**Y is regulated and adjusted to an appropriate amount when the developer G passes through the doctor section, and then the developer G is conveyed to a development area facing the photoconductor **41**Y. In the development area, the toner in the developer G adheres to the latent image formed on the photoconductor **41**Y by a developing electric field generated between the developing roller **51**Y and the photoconductor **41**Y. The developer G remaining on the surface of the developing roller **51**Y that has passed through the development area reaches the upper side of the first developer accommodating section **53**Y along with the rotation of the sleeve. At this position, the developer G is separated from the developing roller **51**Y.

The developer G in the developing device **50**Y is adjusted so that the toner density falls within a predetermined range. Specifically, toner T contained in the toner container **32**Y is replenished to the second developer accommodating section **54**Y by the toner replenishing device **60**Y (to be described later) through the toner dropping passage **64**Y in accordance with the consumption of toner T of the developer G in the developing device **50**Y through the development. The toner T replenished to the second developer accommodating section **54**Y circulates between the first developer accommodating section **53**Y and the second developer accommodating section **54**Y while being mixed and stirred with the developer G by the two developer conveying screws **55**Y.

Next, the toner replenishing devices **60**Y, **60**M, **60**C, **60**K will be described.

FIG. **4** is a schematic perspective view illustrating a state in which the four toner containers **32**Y, **32**M, **32**C, **32**K are attached to the toner container holder **70**. FIG. **5** is a schematic diagram illustrating a state in which the toner container **32**Y is attached to the toner replenishing device **60**Y. The toner replenishing devices **60**Y, **60**M, **60**C, **60**K for the respective colors have the same configurations except that the colors of toner are different. Therefore, in FIG. **5**, explanation of only the toner replenishing device **60**Y and the toner container **32**Y for yellow will be given, and explanation of the toner replenishing devices **60**M, **60**C, **60**K and the toner containers **32**M, **32**C, **32**K for the other three colors will be omitted appropriately. When the configurations vary depending on the colors, a symbol Y, M, C, or K representing a specific color is used. When the configurations do not vary depending on the colors or common to all of the colors, a symbol Y, M, C, or K may be used or all of the symbols may be omitted appropriately. In FIG. **4**, an arrow Q indicates an attachment direction in which the toner containers **32** of the respective colors are attached to the toner replenishing devices **60**, and Q1 indicates a detachment direction in which the toner containers **32** of the respective colors are detached from the toner replenishing devices **60**.

The yellow toner T contained in the toner container **32**Y among the toner containers **32**Y, **32**M, **32**C, **32**K for the respective colors attached to the toner container holder **70** of the printer **100** illustrated in FIG. **4** is appropriately replenished to the developing device in accordance with the consumption of toner in the developing device **50** as illustrated in FIG. **5**. At this time, the toner in the toner container **32**Y is replenished by the toner replenishing device **60**Y. The toner replenishing device **60**Y includes the toner container holder **70**, a conveying nozzle **611**Y serving as a nozzle, a conveying screw **614**Y serving as a main body conveyor, the toner dropping passage **64**Y, a driving part **91**Y serving as a container rotating part, and the like.

The toner replenishing devices for the other colors have the same configurations. When a user performs attachment operation to push the toner container **32**Y in the attachment direction Q in FIG. **5** and the toner container **32**Y is moved inside the toner container holder **70** of the printer **100** along with the attachment direction Q, the conveying nozzle **611**Y of the toner replenishing device **60**Y is inserted from a front side of the toner container **32**Y in the attachment operation Q. Therefore, the toner container **32**Y and the conveying nozzle **611**Y communicate with each other. A configuration for the communication along with the attachment operation will be described in detail later.

The toner container **32**Y may be referred to as a toner bottle. The toner container **32**Y mainly includes a container cover **34**Y serving as a container front end cover or a held portion that is non-rotatably held by the toner container holder **70**, and includes an approximately cylindrical container body **33**Y serving as a powder storage integrated with a container gear **301**Y serving as a container-side gear. The container body **33**Y is rotatably held by the container cover **34**Y. In FIG. **5**, a setting cover **608**Y is a part of a container cover receiving section **73** of the toner container holder **70**.

As illustrated in FIG. **4**, the toner container holder **70** mainly includes the container cover receiving section **73**, a container receiving section **72**, and an insertion hole part **71**. The container cover receiving section **73** is a section for holding the container covers **34**Y, **34**M, **34**C, **34**K and the container bodies **33**Y, **33**M, **33**C, **33**K of the toner containers **32**Y, **32**M, **32**C, **32**K for the respective colors. The container receiving section **72** is a section for supporting the container bodies **33**Y, **33**M, **33**C, **33**K of the toner containers **32**Y, **32**M, **32**C, **32**K. An insertion hole **71***a* serving as an insertion opening used in the attachment operation of the toner containers **32**Y, **32**M, **32**C, **32**K is defined by the insertion hole part **71**. When a main-body cover arranged on the front side of the copier **500** (the front side in the direction normal to the sheet of FIG. **2**) is opened, the insertion hole part **71** of the toner container holder **70** is exposed. Then, attachment/detachment operation of the toner containers **32**Y, **32**M, **32**C, **32**K (attachment/detachment operation with

the longitudinal direction of the toner containers **32** taken as an attachment/detachment direction) is performed from the front side of the copier **500** while the toner containers **32**Y, **32**M, **32**C, **32**K are oriented with their longitudinal directions being parallel to the horizontal direction.

The container receiving section **72** is provided such that its longitudinal length becomes approximately the same as the longitudinal lengths of the container bodies **33**Y, **33**M, **33**C, **33**K of the respective colors. The container cover receiving section **73** is arranged on a container front side (a side in the attachment direction Q) of the container receiving section **72** in the longitudinal direction (attachment/detachment direction), and the insertion hole part **71** is arranged on one end side (a side in the detachment direction Q1) of the container receiving section **72** in the longitudinal direction. The four toner containers **32**Y, **32**M, **32**C, **32**K are able to move on the container receiving section **72** in a sliding manner. Therefore, along with the attachment operation of the toner containers, the container covers **34**Y, **34**M, **34**C, **34**K first pass through the insertion hole part **71**, slides on the container receiving section **72** for a while, and are finally attached to the container cover receiving section **73**.

As illustrated in FIG. **5**, a rotation driving force is input to the container gear **301**Y serving as a gear provided on the container body **33**Y, while the container cover **34**Y is attached to the container cover receiving section **73**. Specifically, the driving part (container rotating part) **91**Y including a driving motor, a driving gear, and the like inputs a rotation driving force to the container gear **301**Y via a container driving gear **601**Y serving as an apparatus main-body gear. Therefore, the container body **33**Y is rotated in the arrow A direction in FIG. **5**. With the rotation of the container body **33**Y, a spiral rib **302**Y has a spiral shape on the inner surface of the container body **33**Y conveys toner in the container body **33**Y from one end on the right side in FIG. **5** to the other end on the left side in FIG. **5** along the longitudinal direction of the container body.

Namely, in the embodiment, the spiral rib **302**Y serves as a rotary conveyor. Consequently, the toner is supplied to the inside of the conveying nozzle **611**Y via a nozzle hole **610**Y serving as a powder receiving hole provided on the conveying nozzle **611**Y, and supplied from the other side of the toner container **32**Y where the container cover **34**Y is attached. The nozzle hole **610**Y communicates with an opening **335***b*, which serves as a shutter side opening of a container shutter supporter (to be described later), at an inner position relative to the position where the container gear **301**Y is arranged in the longitudinal direction of the container body **33**Y. Specifically, the container gear **301**Y meshes with the container driving gear **601**Y on a container opening **33***a* side in the longitudinal direction of the toner container, relative to the position where the nozzle hole **610** and the opening **335***b* of the container shutter supporter communicate with each other.

The conveying screw **614**Y is arranged in the conveying nozzle **611**Y. When the driving part (container rotating part) **91**Y inputs the rotation drive to a conveying screw gear **605**Y, the conveying screw **614**Y rotates to convey the toner T supplied in the conveying nozzle **611**Y. A downstream end of the conveying nozzle **611**Y in the conveying direction is connected to the toner dropping passage **64**Y. The toner T conveyed by the conveying screw **614**Y falls along the toner dropping passage **64**Y by gravity and is replenished to the developing device **50**Y (the second developer accommodating section **54**Y).

The toner containers **32**Y, **32**M, **32**C, **32**K are replaced with new ones at the end of their lifetimes (when the containers become empty because almost all of the stored toner T is consumed). Grippers **303**Y, **303**M, **303**C, **303**K are arranged on one ends of the toner containers **32**Y, **32**M, **32**C, **32**K opposite to the container covers **34**Y, **34**M, **34**C, **34**K in the longitudinal direction in FIG. **4**, that is, on the detachment direction Q1 sides. When the toner containers are to be replaced, an operator can grip the grippers **303**Y, **303**M, **303**C, **303**K to pull out and detach the toner containers **32**Y, **32**M, **32**C, **32**K attached to the toner container holder **70**.

The configuration of the driving part **91** will be further described below with reference to FIG. **6**. In FIG. **6**, symbols representing the colors are omitted. The driving part **91** includes the container driving gear **601** and the conveying screw gear **605**. When a driving motor **603** fixed to a mounting frame **602** is driven and an output gear is rotated, the container driving gear **601** rotates. The conveying screw gear **605** rotates by receiving the rotation of the output gear via a coupled gear **604**.

As illustrated in FIG. **4**, the toner replenishing device **60**Y controls the amount of toner supplied to the developing device **50**Y in accordance with the rotation frequency of the conveying screw **614**Y. Therefore, toner that passes through the conveying nozzle **611**Y is directly conveyed to the developing device **50**Y through the toner dropping passage **64**Y without the need to control the amount of toner supplied to the developing device **50**Y. Even in the toner replenishing device **60**Y configured to insert the conveying nozzle **611**Y into the toner container **32**Y as described in the embodiment, it may be possible to arrange a temporary toner storage, such as a toner hopper. In the toner replenishing devices **60**M, **60**C, **60**K for the other colors, the supply amount of toner is controlled in the same manner as in the toner replenishing device **60**Y.

The toner containers **32**Y, **32**M, **32**C, **32**K and the toner replenishing devices **60**Y, **60**M, **60**C, **60**K according to the embodiment will be described in detail below. As described above, the toner containers **32**Y, **32**M, **32**C, **32**K and the toner replenishing devices **60**Y, **60**M, **60**C, **60**K have almost the same configurations except that the colors of toner to be used are different. Therefore, in the following descriptions, symbols Y, M, C, and K representing the colors of toner will be omitted.

FIG. **1** is an explanatory cross-sectional view of the toner replenishing device **60** before the toner container **32** is attached and a front end of the toner container **32**. FIG. **7** is an explanatory perspective view of the toner container **32** viewed from above the container cover **34**. FIG. **8** is an explanatory cross-sectional view of the toner replenishing device **60** to which the toner container **32** is attached and the front end of the toner container **32**. FIG. **9** is a perspective view illustrating a configuration of the container cover receiving section **73** of the toner container holder **70**.

The toner replenishing device **60** includes the conveying nozzle **611** in which the conveying screw **614** is arranged, and a nozzle shutter **612**. The nozzle shutter **612** is slidably mounted on the outer surface of the conveying nozzle **611** so as to close the nozzle hole **610** at the time of detachment, which is before the toner container **32** is attached (in the state in FIG. **1**), and to open the nozzle hole **610** at the time of attachment, which is when the toner container **32** is attached (in the state in FIG. **8**). The nozzle shutter **612** includes a nozzle shutter flange **612***a* serving as a flange on the downstream side in the attachment direction relative to an end surface of a nozzle receiver **330** serving as a nozzle insertion member (to be described later) that comes in contact with the conveying nozzle **611**.

As illustrated in FIG. **7**, a receiving opening **331**, which serves as a nozzle insertion opening into which the conveying nozzle **611** is inserted at the time of attachment, is provided in the center of the front end of the toner container **32**. In the receiving opening **331**, a container shutter **332** is provided, which serves as an opening/closing member that opens and closes the receiving opening **331**. Specifically, the toner container **32** according to the embodiment stores therein toner and is able to supply toner from the nozzle receiver **330** to the conveying nozzle **611**. The conveying nozzle **611** provided on the toner replenishing device **60** on the image forming apparatus side is inserted in and removed from the nozzle receiver **330**. The copier **500** includes the conveying nozzle **611** that is inserted in the receiving opening **331** along with the attachment operation of the toner container **32** and that receives toner supplied from the toner container **32**.

As illustrated in FIG. **4**, the container receiving section **72** arranged on the toner container holder **70** is divided into four sections in a width direction W perpendicular to the longitudinal direction (attachment/detachment direction) of the toner container **32**. The container receiving section **72** is provided with gutters **74** serving as container mounting sections as illustrated in FIG. **9**. The gutters **74** extend from the insertion hole part **71** to the container cover receiving section **73** along the longitudinal direction of the container bodies **33**Y, **33**M, **33**C, **33**K. The toner containers **32**Y, **32**M, **32**C, **32**K for the respective colors are able to move on the gutters **74** in a sliding manner in the longitudinal direction.

As illustrated in FIG. **9**, on side surfaces **74***a* and **74***b* of the gutter **74**, which are opposite surfaces arranged in the width direction W, guide rails **75** are arranged so as to face each other. The guide rails **75** protrude in the width direction W from the respective side surfaces **74***a* and **74***b*, extend in the longitudinal direction, and are arranged in front of the container cover receiving section **73**. The guide rails **75** are fitted to sliding guides **361** serving as guiding portions on the toner container **32** side as illustrated in FIG. **7** when the toner container **32** is attached to the printer **100** (the toner container holder **70** and the toner replenishing device **60**). The fitting described herein means that the guide rails **75** are inserted in grooves provided on the sliding guides **361** in a movable manner. The guide rails **75** have functions to guide the container opening **33***a* serving as the opening to a container setting section **615** serving as a container receiving section by being fitted to the sliding guides **361**. Each of the guide rails **75** is provided so as to be parallel to the rotation axis of the container body **33** when the toner container **32** is attached to the toner replenishing device **60**.

As illustrated in FIG. **9**, the setting cover **608** for each color is arranged on the container cover receiving section **73**. The conveying nozzle **611** is disposed in the center of the setting cover **608**. The conveying nozzle **611** is arranged so as to protrude from an end surface **615***b*, which is on the inner side in the attachment direction, of the container setting section **615**, which is located on the downstream side in the attachment direction of the toner container **32**, toward the upstream side in the attachment direction inside the container cover receiving section **73**. The container setting section **615** serving as the container receiving section is arranged in the protruding direction of the conveying nozzle **611**, that is, toward the upstream side in the attachment direction (to the detachment direction Q1 side) of the toner container **32** so as to surround the conveying nozzle **611**. Specifically, the container setting section **615** is arranged at the base of the conveying nozzle **611** and serves as a positioner to determine the position of the container opening **33***a* relative to the toner container holder **70**. The container opening **33***a* functions as a rotational shaft when the rotary conveyor inside the toner container **32** rotates to convey the toner stored in the toner container **32**. Namely, when the container opening **33***a* is inserted in and mated to the container setting section **615**, the radial position of the container opening **33***a* is determined.

When the toner container **32** is attached to the toner replenishing device **60**, an outer surface **33***b* of the container opening **33***a* of the toner container **32** is slidably mated to the container setting section **615**. On an inner surface **615***a* of the container setting section **615**, contact surfaces **615***d* are provided. The contact surfaces **615***d* are parts of the inner surface **615***a* of the container setting section **615** and protrude inward in the radial direction from the inner surface **615***a* of the container setting section **615**. The contact surfaces **615***d* are provided at four evenly-spaced positions. The contact surfaces **615***d* and the outer surface **33***b* slide against each other along with the rotation of the toner container **32**.

By the mating of the inner surface **615***a* of the container setting section **615** and the outer surface **33***b* of the container opening **33***a* of the toner container **32**, the position of the toner container **32** relative to the toner replenishing device **60** in the radial direction perpendicular to the longitudinal direction (attachment/detachment direction) of the toner container **32** is determined. When the toner container **32** rotates, the outer surface **33***b* of the container opening **33***a* functions as a rotational shaft, and the inner surface **615***a* of the container setting section **615** functions as a bearing. In FIG. **8**, α indicates the position at which the outer surface **33***b* of the container opening **33***a* comes in sliding contact with the contact surfaces **615***d* as the parts of the inner surface **615***a* of the container setting section **615** and at which the radial position of the toner container **32** relative to the toner replenishing device **60** is determined at this time.

In the descriptions below, it is repeatedly explained that the outer surface **33***b* of the container opening **33***a* of the toner container **32** and the container setting section **615** mate with each other in a slidable manner. The mating state is, in a precise sense, a state in which the outer surface **33***b* of the container opening **33***a* of the toner container **32** is in contact with the contact surfaces **615***d* provided on the inner surface **615***a* of the container setting section **615**. Hereinafter, for simplicity of explanation, the mating will be referred to as mating the outer surface **33***b* of the container opening **33***a* with the inner surface **615***a* of the container setting section **615** by omitting the contact surfaces **615***d*.

As illustrated in FIG. **9**, holes **608***d* are provided so as to face each other in the width direction W of the setting cover **608**. On the setting cover **608**, replenishing device engaging members **78** (to be described later) are arranged so as to be able to move back and forth from the outer surface to an inner surface **608***c* side of the setting cover **608** via the holes **608***d*. The replenishing device engaging members **78** are biased from the outer side to the inner side of the setting cover **608** by biasing means, such as torsion coil springs **782**.

The toner container **32** will be described below.

As illustrated in FIG. **7**, the toner container **32** mainly includes the container body **33** containing toner, and includes the container cover **34**. In FIG. **7**, illustration of toner is omitted. The container body **33** is in the form of an approximate cylinder and rotates about a central axis of the cylinder as a rotation axis. Hereinafter, one side of the toner container **32** where the receiving opening **331** is provided (the side where the container cover **34** is arranged) in the longitudinal direction of the toner container **32** may be

referred to as "a container front end". The other side of the toner container **32** where the gripper **303** is arranged (the side opposite the container front end) may be referred to as "a container rear end". The longitudinal direction of the toner container **32** is the rotation axis direction, and corresponds to the horizontal direction when the toner container **32** is attached to the toner replenishing device **60**. The container rear end of the container body **33** relative to the container gear **301** has a greater outer diameter than that of the container front end, and the spiral rib **302** is provided on the inner surface of the container body **33**. When the container body **33** rotates in an arrow A direction in the figures, a conveying force for moving toner from one end (the container rear end) to the other end (the container front end) in the rotation axis direction is applied to the toner in the container body **33** due to the action of the spiral rib **302**.

As illustrated in FIG. **8**, scooping portions **304** are provided on the inner wall of the container front end of the container body **33**. The scooping portions **304** scoop up the toner T conveyed to the container front end by the spiral rib **302** along with the rotation of the container body **33** in the arrow A direction in the figures. Each of the scooping portions **304** scoops up the toner T, which has been conveyed by the conveying force of the spiral rib **302**, by using a scooping wall surface **304***f* along with the rotation of the container body **33**. Therefore, the toner T can be scooped up so as to be located above the inserted conveying nozzle **611**. As illustrated in FIGS. **1** and **8** for example, a rib **304***a* in a spiral shape is provided on the inner surface of each of the scooping portions **304** in order to convey the internally-located toner, similarly to the spiral rib **302**.

As illustrated in FIGS. **7** and **8**, the container gear **301** is provided on the container front side relative to the scooping portions **304** on the container body **33**. A gear exposing opening **34***a* is arranged on the container cover **34** so that a part of the container gear **301** can be exposed when the container cover **34** is attached to the container body **33**. When the toner container **32** is attached to the toner replenishing device **60**, the container gear **301** exposed from the gear exposing opening **34***a* meshes with the container driving gear **601** of the toner replenishing device **60**. The container gear **301** is arranged on the container opening **33***a* side (near the container opening **33***a*) relative to the nozzle hole **610** in the longitudinal direction of the container body **33** such that the container gear **301** can mesh with the container driving gear **601**. The container gear **301** meshes with the container driving gear **601** to thereby rotate the rotary conveyor.

The container opening **33***a* in the form of a cylinder is provided on the container front side relative to the container gear **301** of the container body **33** so as to be coaxial with the container gear **301**. As illustrated in FIGS. **1** and **8**, a nozzle receiver attachment portion **337** of the nozzle receiver **330** is press fitted to the container opening **33***a* so as to be coaxial with the container opening **33***a*, so that the nozzle receiver **330** is fixed to the container body **33**. The toner container **32** is configured such that toner T is replenished from the container opening **33***a* serving as the opening provided on one end of the container body **33**, and thereafter, the nozzle receiver **330** is attached to the container opening **33***a* of the container body **33**.

As illustrated in FIG. **7**, a cover hook stopper **306** serving as a restrictor is provided between the container opening **33***a* of the container body **33** and the container gear **301**. The cover hook stopper **306** has a ring shape extending in the rotation direction (circumferential direction) on the front end of the container cover **34** in the attachment direction.

The container cover **34** is attached to the toner container **32** (the container body **33**) from the container front end (from the bottom left side in FIG. **8**). Therefore, the container body **33** penetrates through the container cover **34** in the longitudinal direction, and cover hooks **3410** serving as protrusions are engaged with the cover hook stopper **306** serving as the restrictor. The container body **33** and the container cover **34** are attached so as to rotate relative to each other when the cover hooks **3410** are engaged with the cover hook stopper **306**.

As illustrated in FIG. **7**, on the container cover **34** of the toner container **32**, the sliding guides **361** serving as guiding portions are provided on lower portions in the width direction W. In FIG. **7**, only one of the sliding guides **361** is illustrated. Each of the sliding guides **361** restricts the toner container **32** being attached from moving in directions other than the attachment direction to thereby guide the container opening **33***a* to the container setting section **615**. Each of the sliding guides **361** includes a gutter extending in the longitudinal direction of the container body **33**. The sliding guides **361** are configured such that the guide rails **75**, as a pair, provided on the gutters **74** of the container receiving section **72** as illustrated in FIG. **9** are inserted in the respective gutters and sandwiched in the vertical direction. Therefore, the sliding guides **361** function as positioners of the container cover **34** in the width direction W perpendicular to a vertical direction Z and the detachment direction Q1 when the toner container **32** is attached to the printer **100** (the toner replenishing device **60** and the toner container holder **70**).

A configuration of the nozzle receiver **330** will be described below with reference to FIGS. **10** and **11**A to **11**D. As illustrated in FIGS. **11**A to **11**D, the nozzle receiver **330** is arranged on the toner container **32**, and includes the receiving opening **331** serving as a nozzle insertion opening. The conveying nozzle **611** for conveying toner supplied from the toner container **32** in the copier **500** is inserted in and removed from the receiving opening **331**. The nozzle receiver **330** includes the container shutter **332**, a container seal **333** serving as a seal, a container shutter supporter **334** serving as a supporter, a container shutter spring **336** serving as a biasing member, and the nozzle receiver attachment portion **337**. The container shutter **332** is inserted in and supported by the container shutter supporter **334** in a reciprocating manner so as to move to the opening position to open the receiving opening **331** by being pressed along with insertion of the conveying nozzle **611**, and to move a closing position to close the receiving opening **331** along with removal of the conveying nozzle **611**. Namely, the container shutter supporter **334** supports the container shutter **332** so as to guide the container shutter **332** to move to the opening position and the closing position. The container shutter spring **336** is a coil spring that is arranged inside the container shutter supporter **334** and biases the container shutter **332** toward the closing position. While the container shutter spring **336** biases the container shutter **332** toward the closing position in the embodiment, a configuration without the container shutter spring **336** may be applicable.

The container shutter supporter **334** includes a shutter rear end supporting portion **335** as a rear portion, a pair of shutter side supporting portions **335***a* as side portions, the openings **335***b* as shutter side openings of the container shutter supporter, and the nozzle receiver attachment portion **337**. The shutter side supporting portions **335***a* are arranged so as to face each other, and extend along the moving direction of the container shutter **332**. One ends of the shutter side supporting portions **335***a* are connected by the shutter rear

end supporting portion **335**, and the other ends are connected to the cylindrical nozzle receiver attachment portion **337**. The shutter side supporting portions **335***a* and the openings **335***b* are arranged adjacent to each other in the rotation direction of the toner container. Namely, the container shutter supporter **334** has a shape in which cylindrical portions corresponding to the shutter side supporting portions **335***a* from the nozzle receiver attachment portion **337** side to the shutter rear end supporting portion **335** are vertically cut out along the moving direction of the container shutter **332**. The openings **335***b* are provided in the cutout portions of the container shutter supporter **334**. The container shutter supporter **334** is configured such that the container shutter **332** can move along the insertion direction of the conveying nozzle **611** in a space S**1**. The space S**1** is enclosed by the pair of the shutter side supporting portions **335***a*, the shutter rear end supporting portion **335**, and the nozzle receiver attachment portion **337**. In other words, the container shutter supporter **334** is configured to be able to guide the movement of the container shutter **332** to the opening position to open the receiving opening **331** and the closing position to close the receiving opening **331**.

As illustrated in FIGS. **11**A to **11**D, the conveying nozzle **611** is inserted in the nozzle receiver **330**, and the container shutter **332** starts to move by being pushed by a front end (end surface) **611***a* of the conveying nozzle **611**. At this time, the toner T remains in the space S**1**. The space S**1** is defined by the two shutter side supporting portions **335***a* of the container shutter supporter **334** that guides the container shutter **332** and by the shutter rear end supporting portion **335** of the container shutter supporter **334**. The container shutter spring **336** is held in the space S**1**. The shutter rear end supporting portion **335** has a cylindrical shape; therefore, the toner T is likely to be accumulated in the cylindrical portion. Therefore, as illustrated in FIGS. **11**B to **11**D, the toner T is pressed between a rear end surface (edge) **332***da* of a slide area (gliding portion or sealing portion) **332***d* of the container shutter **332** and an opposite surface of the shutter rear end supporting portion **335** of the nozzle receiver **330**.

The toner T is pressed and compressed between the rear end surface **332***da* of the slide area **332***d* of the container shutter **332** and the opposite surface of the shutter rear end supporting portion **335** of the container shutter supporter **334** (the nozzle receiver **330**) as described above. Therefore, when the toner container **32** is further pushed, the compressed toner enters between the slide area **332***d* of the container shutter **332** and the two shutter side supporting portions **335***a* of the container shutter supporter **334** (the nozzle receiver **330**). If the compressed and cohered toner enters between the slide area **332***d* of the container shutter **332** and the two shutter side supporting portions **335***a* of the container shutter supporter **334** (the nozzle receiver **330**) as described above, the container shutter **332** is prevented from returning to the closing position when the toner container **32** is detached from the copier **500**. Consequently, the toner container **32** may be detached while the receiving opening **331** remains open, resulting in toner leakage.

Therefore, the nozzle receiver **330** serving as the nozzle insertion member according to the embodiment includes an inner cap **340** as illustrated in FIGS. **12**A and **12**B. The inner cap **340** longitudinally covers the slide area **332***d* and the container shutter supporter (supporter) **334** when the slide area (sealing portion) **332***d* of the container shutter (opening/closing member) **332** is located at the closing position. By covering the container shutter supporter **334** by the inner cap **340** from the outside, it is possible to obtain an approximately sealed state so as to prevent the toner T from entering between the slide area **332***d* of the container shutter **332** and the two shutter side supporting portions **335***a* of the nozzle receiver **330**. Therefore, it is possible to prevent the toner T from entering the space S**1** in which the container shutter **332** moves along with opening and closing of the receiving opening **331** as illustrated in FIGS. **11**A to **11**D. This prevents the toner T from being compressed. Therefore, the container shutter **332** is not prevented from returning to the closing position, so that it becomes possible to prevent the toner container **32** from being detached while the receiving opening **331** remains open, enabling to prevent toner leakage.

Configurations of the inner cap **340** and the container shutter supporter **334** to which the inner cap **340** is attached will be described below.

The inner cap **340** is supported on the outer side of the container shutter supporter **334** so as to be able to slide between a closure position, at which the two shutter side supporting portions **335***a* of the container shutter supporter **334** are covered as illustrated in FIG. **14**A, and a release position, at which parts of the two shutter side supporting portions **335***a* are opened as illustrated in FIG. **14**C. Namely, the inner cap **340** is movable along the longitudinal sides of the shutter side supporting portions **335***a*. The release position of the inner cap **340** is a position at which the nozzle hole **610** is opened between the two shutter side supporting portions **335***a* when the conveying nozzle **611** is inserted in the container shutter supporter **334** (for example, see FIG. **8**). Specifically, when the inner cap **340** is located at the closure position, the entire longitudinal area of the container shutter supporter **334** is covered by the inner cap **340** from the outside. When the inner cap **340** is located at the release position, a part of the container shutter supporter **334** is exposed. More specifically, when the inner cap **340** is located at the release position, a part of the container shutter supporter **334** is exposed such that the nozzle hole **610** of the conveying nozzle **611** is exposed between the two shutter side supporting portions **335***a* of the container shutter supporter **334** so as to communicate with the inside of the toner container **32** to enable toner supply.

As illustrated in FIG. **12**B, the inner cap **340** has a cylindrical shape with a closed end **341***a* on one end in the longitudinal direction and with an opening **340***b* on the other end. The size and the length of the internal space are defined so as to cover the container shutter supporter **334** from the outside. On the opening **340***b* side of the inner cap **340**, an inner side protrusion **341** is provided so as to protrude toward the inside of the cap relative to an inner surface **340***c* of the inner cap **340**. Specifically, the inner side protrusion **341** protrudes toward outer surfaces **335***a***1** of the container shutter supporter **334** housed in the inner cap **340**. The inner side protrusion **341** may be provided circularly in the circumferential direction of the inner cap **340**, or may be provided intermittently in the circumferential direction of the inner cap **340**. On the inner surface **340***c* between the inner side protrusion **341** and a closed end **340***a* that is a closure portion of the inner cap, a sealing protrusion **343**A protrudes toward the inside of the cap so as to have a ring shape.

The inner cap **340** configured as described above is attached from the opening **340***b* at the leading end in a direction from a shutter hook **332***a* side to the nozzle receiver attachment portion **337**. The shutter hook **332***a* is provided on the front end of a guiding rod (elongated portion) **332***e* that is a part of the container shutter **332**. Specifically, the container shutter supporter **334** of the

nozzle receiver **330** is inserted in the inner cap **340** from the opening **340***b* to the closed end **340***a* of the inner cap **340**.

On the closed end **340***a*, an opposing surface **340***d* as an inner end surface is provided. The opposing surface **340***d* faces an end surface **332***a***1** of the shutter hook **332***a* when the inner cap **340** is attached to the container shutter supporter **334**. The end surface **332***a***1** is a part of the container shutter (opening/closing member) **332**. The opposing surface **340***d* is a flat surface that crosses the moving direction of the container shutter **332**. It is more preferable that the opposing surface **340***d* be a flat surface perpendicular to the moving direction of the container shutter **332**. The opposing surface **340***d* is disposed on an opening position side of the container shutter **332** so as to be pushed by the end surface **332***a***1** of the shutter hook **332***a* when the container shutter **332** moves to the opening position. Specifically, the inner cap **340** includes the opposing surface **340***d* serving as the inner end surface that comes in contact with the end surface **332***a***1** of the shutter hook **332***a* that is a part of the container shutter **332** when the container shutter **332** moves to the opening position.

The inner cap **340** is configured such that a projected area of the outer surface of the closed end **340***a*, which is an end on a release position side, in the moving direction of the container shutter **332** is smaller than the projected area of a cylindrical portion **340***e*, which is a portion on a closure position side, in the moving direction of the container shutter **332**. In the embodiment, the closed end **340***a* has a conical shape and has a smaller projected area than the projected area of the cylindrical portion **340***e*.

On the two shutter side supporting portions **335***a* of the container shutter supporter **334**, as illustrated in FIGS. **12**B, **13**A, and **13**B, cap stoppers **345** are provided. The cap stoppers **345** protrude from the outer surfaces **335***a***1** of the supporter to the inner surface **340***c* of the inner cap **340**, and are disposed on the release position side relative to the inner side protrusion **341**. The cap stoppers **345** come in contact with the inner side protrusion **341** near the release position when the inner cap **340** is pushed along with the movement of the container shutter **332** to the opening position, and restricts the movement of the inner cap **340** in the pushing direction (the moving direction Q1 toward the opening position) in order to prevent the inner cap **340** from being detached from the container shutter supporter **334**. Specifically, the shutter side supporting portions **335***a* include the cap stoppers **345** protruding from the outer surfaces **335***a***1** of the shutter side supporting portions **335***a* to the inner surface **340***c* of the inner cap **340**.

The container shutter supporter **334** includes an engaging groove **342**. The engaging groove **342** serves as a cap holder and is provided at the supporter that is engaged with the inner side protrusion. The engaging groove **342** holds the inner cap **340** when the inner cap **340** is located at the closure position at which it longitudinally covers the container shutter supporter **334** as illustrated in FIGS. **12**B and **14**A. The engaging groove **342** is disposed between the two shutter side supporting portions **335***a* and the nozzle receiver attachment portion **337**, and faces the slide area **332***d* when the container shutter **332** is located at the closing position. The engaging groove **342** is a groove recessed from the outer surfaces **335***a***1** toward the slide area **332***d*. The inner side protrusion **341** is inserted in and hooked on the engaging groove **342** provided as the groove when the inner cap **340** is attached to the container shutter supporter **334**. When the inner side protrusion **341** is hooked on the engaging groove **342**, the inner cap **340** is held at the closure position.

As illustrated in FIG. **12**B, the nozzle receiver **330** includes a sealing portion **343** that seals a space S2 between the shutter side supporting portions **335***a* (the container shutter supporter **334**) and the inner surface **340***c* of the inner cap **340** when the inner cap **340** is located at the closure position. The sealing portion **343** includes the sealing protrusion **343**A provided on the inner cap **340** and a sealing surface **343**B provided on the shutter side supporting portions **335***a* (the container shutter supporter **334**). The sealing surface **343**B of the supporter protrudes from the outer surfaces **335***a***1** of the shutter side supporting portions **335***a* toward the inner surface **340***c* of the inner cap **340**. The sealing surface **343**B of the supporter comes in contact with the sealing protrusion **343**A when the inner cap **340** is attached to the container shutter supporter **334**, in particular, when the inner cap **340** approaches the closure position, or more preferably, when the inner cap **340** is located at the closure position, and seals a gap between the shutter side supporting portions **335***a* (the container shutter supporter **334**) and the inner surface **340***c* of the inner cap **340**.

The sealing surface **343**B of the supporter includes an inclined surface **343**Ba. The inclined surface **343**Ba has a ring shape and inclined downward in a cap moving direction (an arrow Q1 direction in the figure) in which the inner cap **340** is pushed and moved from the closure position to the release position along with the movement of the container shutter **332**. The inclined surface **343**Ba faces a sealing surface (contacting surface) **343**Aa of the sealing protrusion **343**A, and comes in contact with an inner surface **343***a* on the release position side relative to the closure position when the inner cap **340** moves. Specifically, the inclined surface **343**Ba is configured such that when the inner cap **340** moves to the release position, the sliding resistance against the sealing surface **343**Aa is reduced and the container shutter **332** can smoothly move in the opening direction, and, when the inner cap **340** moves to the closure position, the sliding resistance against the inner surface **343***a* is increased and a sealing performance can be ensured. To ensure a higher sealing performance, it is preferable that the sealing surface **343**Aa of the sealing protrusion **343**A be provided as an inclined surface parallel to the inclined surface **343**Ba.

When the inner cap **340** moves to the release position, the inner side protrusion **341** provided on the closure position side relative to the sealing protrusion **343**A is separated from the engaging groove **342** and moves on the inclined surface **343**Ba of the sealing surface **343**B. When the inner cap **340** moves to the closure position, the inner side protrusion **341** passes on the inclined surface **343**Ba, enters the engaging groove **342**, and is held by the engaging groove **342**. Therefore, the inner side protrusion **341** is provided so as to be elastically deformable.

Movement of the inner cap **340** between the closure position and the release position will be described below with reference to FIGS. **14**A to **14**C. FIG. **14**A illustrates the states of the inner cap **340**, the container shutter **332**, and the container shutter supporter **334** when the inner cap **340** is located at the closure position. FIG. **14**B illustrates the states of the inner cap **340**, the container shutter **332**, and the container shutter supporter **334** when the inner cap **340** is moving from the closure position to the release position. FIG. **14**C illustrates the states of the inner cap **340**, the container shutter **332**, and the container shutter supporter **334** when the inner cap **340** is located at the release position.

As illustrated in FIG. **14**A, when the inner side protrusion **341** enters the engaging groove **342**, the inner cap **340** is held by the container shutter supporter **334** at the closure position. At this time, the container shutter supporter **334** is

in the approximately sealed state. Therefore, a container sealed side of the container shutter supporter **334** (the nozzle receiver **330**) is covered by the inner cap **340** until the toner container **32** is set in the toner replenishing device **60**, and the toner T does not enter between the slide area **332***d* of the container shutter **332** and the two shutter side supporting portions **335***a* of the nozzle receiver **330**. Consequently, even if the fluidity of the toner T is reduced due to transportation or storage, the toner T is not compressed. Therefore, the container shutter **332** is not prevented from moving back to the closing position when the toner container **32** is detached from the copier **500**. Consequently, it is possible to prevent the toner container **32** from being detached while the receiving opening **331** remains open, enabling to prevent toner leakage. Namely, it is possible to prevent the toner T from entering an opening/closing region of the container shutter **332**, and it is possible to more reliably prevent a situation in which the container shutter **332** is prevented from returning to the closing position by the toner T.

When the toner container **32** is moved in the attachment direction Q of the toner replenishing device **60**, the container shutter **332** is moved in the opening direction (arrow Q1) by the conveying nozzle **611**. Therefore, the opposing surface **340***d* of the inner cap **340** is pushed by the end surface **332***a***1** of the shutter hook **332***a* of the container shutter **332**, and the inner side protrusion **341** is elastically deformed and separated from the engaging groove **342**. As a result, the approximately sealed state is released. Further, the contact state of the contacting surface **343**Aa of the sealing protrusion **343**A and the inclined surface **343**Ba of the sealing surface **343**B of the supporter is released.

When the container shutter **332** is further moved in the opening direction by the conveying nozzle **611**, as illustrated in FIG. **14**B, the inner cap **340** moves from the closure position to the release position along with the movement of the container shutter **332**. Then, the sealing protrusion **343**A passes by the cap stopper **345**. When the container shutter **332** is further moved in the opening direction by the conveying nozzle **611**, as illustrated in FIG. **14**C, the inner side protrusion **341** comes in contact with the cap stopper **345**, and the inner cap **340** is located at the release position and is restricted from moving further. Therefore, it is possible to prevent the inner cap **340** from coming off from the container shutter supporter **334**. By preventing the inner cap **340** from coming off, it is possible to prevent the inner cap **340** from rolling and causing a noise to occur in the toner container **32**, or to prevent the inner cap **340** from covering the conveying nozzle **611** and disturbing toner conveyance.

In the embodiment, the contacting surface **343**Aa of the sealing protrusion **343**A and the inclined surface **343**Ba of the sealing surface **343**B of the supporter in the sealing portion **343** are provided as inclined surfaces. Therefore, the inclined contacting surface **343**Aa of the sealing protrusion **343**A and the inclined surface **343**Ba of the sealing surface **343**B of the supporter come in close contact with each other in the circumferential direction. Consequently, it is possible to reliably maintain the sealed state of the container shutter supporter **334** by the inner cap **340**.

In the embodiment, the outer surface of the closed end **340***a* of the inner cap **340** has a conical shape so as to have a smaller projected area than the projected area of the cylindrical portion **340***e*. More specifically, the inner cap **340** is in the form of a protrusion such that it protrudes from the closed end **340***a* (end portion) located distant from the slide area **332***d* in the longitudinal direction when the container shutter **332** is located at the closing position, and such that the projected area is reduced from the upstream side to the downstream side in the moving direction in which the container shutter **332** moves from the closing position to the opening position. If the fluidity of toner around the inner cap **340** is reduced due to transportation or storage, this causes resistance when the container shutter **332** moves in the opening direction occurs. However, by reducing the projected area of the closed end **340***a* located on a moving direction side to which the container shutter **332** moves along the opening direction, it is possible to reduce the resistance.

In the embodiment, the sealing portion **343** is configured such that the sealing protrusion **343**A is provided on the inner cap **340**, the sealing surface **343**B is provided on the two shutter side supporting portions **335***a*, and the contacting surface **343**Aa and the inclined surface **343**Ba are provided as inclined surfaces parallel to each other; however, the configuration is not limited thereto. For example, as another example as illustrated in FIG. **15**, the sealing portion may be configured such that a seal **347** made of an elastic material or a foamed material is disposed between the outer surfaces **335***a***1** of the two shutter side supporting portions **335***a* and the inner surface **340***c* of the inner cap **340**. In this case, because the two shutter side supporting portions **335***a* and the inner cap **340** move relative to each other, it is preferable to provide the seal **347** on only one of the outer surfaces **335***a***1** of the shutter side supporting portions **335***a* and the inner surface **340***c* of the inner cap **340** so as to come in contact with or be press fitted to both of the surfaces, in view of ensuring the sealing performance.

In this configuration, less stress is applied at the time of sealing, as compared to the configuration in which the sealing protrusion **343**A and the sealing surface **343**B of the supporter are provided as protrusions protruding from the inner surface **340***c* of the inner cap **340** and the outer surfaces **335***a***1** of the two shutter side supporting portions **335***a*. Therefore, higher assembly performance and higher durability can be obtained. Thus, there is an advantage that the sealed state of the container shutter supporter **334** by the inner cap **340** can more reliably be ensured.

The resistance occurs when the container shutter **332** moves in the opening direction. To cope with this, in the embodiment, the outer surface (external appearance) of the closed end **340***a* has a conical shape in order to reduce the projected area of the closed end **340***a* that is located on the moving direction side to which the container shutter **332** moves along the opening direction, as compared to the projected area of the cylindrical portion **340***e* that is located in the direction opposite to the moving direction along the opening direction. However, as long as the projected area of the closed end **340***a* is smaller than the projected area of the cylindrical portion **340***e*, the shape is not limited to the conical shape. As the configuration of the closed end **340***a*, as still another example as illustrated in FIG. **16**, it may be possible to provide, on the inner cap **340**, an end surface **340***aa* perpendicular to the moving direction of the container shutter **332** and grooves **340***ab* at the end surface **340***aa* in order to reduce the projected area of the cylindrical portion **340***e* in the moving direction of the container shutter **332**.

Second Embodiment

A second embodiment of the present invention will be described below with reference to FIGS. **17** to **23**. The same components as those of the first embodiment will be denoted by the same reference signs.

In the first embodiment, the container shutter supporter **334** is covered by the inner cap **340** from the outside so as

to prevent the toner T from entering the space S1 between the two shutter side supporting portions **335***a* of the nozzle receiver **330** during transportation of the toner container **32** or the like. In other words, by providing the inner cap **340**, the toner T is not compressed when the container shutter **332** moves from the closing position to the opening position. Therefore, the container shutter **332** is not prevented from moving back to the closing position by compressed toner T. Consequently, it is possible to prevent the toner container **32** from being detached while the receiving opening **331** remains open, enabling to prevent toner leakage.

Even in the second embodiment of the present invention, the toner T is prevented from entering a space (movement space) S3 in a moving region of the container shutter **332** inside the container shutter supporter **334** in order to address the above described issue. Therefore, the second embodiment is based on the same technical ideas as those of the first embodiment.

The space S1 is a space enclosed by the shutter side supporting portions **335***a*, the shutter rear end supporting portion **335**, and the nozzle receiver attachment portion **337**, and therefore is greater than the space S3.

Detailed explanation will be given below with reference to the drawings.

In the second embodiment, as illustrated in FIG. **17**, an insertion part **2341** to be inserted in the receiving opening **331** is provided on a cap (outer cap) **2340** that is detachably attached to the outer surface **33***b* of the container opening **33***a* and that seals the receiving opening **331** and the container opening **33***a* when attached to the outer surface **33***b* of the container opening **33***a*.

The cap **2340** is made of resin. The cap **2340** is provided with a female screw **2342** inside a closed-end inside space **2343** of the screw of the cap, that is, inside a cap space. The female screw **2342** is screwed with a male screw **33***d* provided on the outer surface **33***b* of the container opening **33***a*. The female screw **2342** may be provided on the outer surface **33***b* and the male screw **33***d* may be provided on the inside space **2343**. The inside space **2343** is provided so as to protrude from a disk-shaped base **2344** in an axial direction (the detachment direction Q1). A handle **2346** is provided on the side opposite to the inside space **2343** across the base **2344**. The cap **2340** is attached to the outer surface **33***b* of the container opening **33***a* (the container body **33**) by screwing the female screw **2342** with the male screw **33***d*. In the second embodiment, a position at which the cap **2340** is fully screwed and attached to the outer surface **33***b* of the container opening **33***a* as illustrated in FIGS. **18** and **19** is referred to as an attachment completed position.

The insertion part **2341** is a rod portion extending from the base **2344** in the axial direction, and includes an end portion **2341***a* that is located on the opening position side of the container shutter **332** relative to an end portion **2343***a* of the inside space **2343** and that protrudes outward. The insertion part **2341** pushes the container shutter **332** toward the inside of the container body **33** when the cap **2340** is attached to the outer surface **33***b* of the container opening **33***a*. Specifically, the end portion **2341***a* includes a contact surface **2341***b* that faces and comes in contact with an end surface **332***h* of the front cylindrical portion of the container shutter **332**.

The insertion part **2341** has a length L2 so as to fill the space (movement space) S3 of a moving region L1 of the container shutter **332** inside the container shutter supporter **334** when the cap **2340** is located at the attachment completed position.

When the cap **2340** configured as described above is attached to the outer surface **33***b* of the container opening **33***a* of the container body **33**, it is possible to prevent the toner T with the low fluidity from entering the space (movement space) S3 of the moving region L1 of the container shutter **332**. Therefore, is possible to prevent a situation in which the toner inside the container body **33** prevents the container shutter **332** from moving to the closing position.

As illustrated in FIG. **20**A, the container shutter **332** is biased toward the closing position by the container shutter spring **336**. Therefore, if the cap **2340** is detached from the container opening **33***a* of the container body **33**, the container shutter **332** moves to the closing position following the cap **2340** as illustrated in FIG. **20**B. Therefore, because the toner T is not provided in the space (movement space) S3 in which the container shutter **332** moves, even when the toner container **32** is set in the toner replenishing device **60** as illustrated in FIG. **8**, the toner T with the low fluidity is not compressed by the container shutter **332** and does not prevent the container shutter **332** from moving back to the closing position.

Even if the toner T flows into the movement space S3 of the container shutter **332** that has moved following the cap **2340** as illustrated in FIGS. **20**A to **20**C, when the toner container **32** is set in the toner replenishing device **60** and the container shutter **332** moves to the opening position again as illustrated in FIGS. **11**A to **11**D, the space S3 into which the toner T has flown is made. This provides an escape for the toner T and prevents the toner T from being compressed.

It is desirable that the length L2 of the insertion part **2341**, which is an insertion distance of the insertion part **2341** in the nozzle receiver **330** as illustrated in FIG. **21**A, be set to be longer than an insertion length L3 of the conveying nozzle **611** in the receiving opening **331**, which is an insertion distance of the conveying nozzle **611** in the nozzle receiver **330** as illustrated in FIG. **21**B. This is because, if the length (insertion distance) L2 of the insertion part **2341** is longer than the insertion length (insertion distance) L3 of the conveying nozzle **611**, when the toner T flows into the movement space S3 in the container shutter **332** that has moved following the cap **2340**, the space S3 as an escape for the toner T at the time of insertion of the conveying nozzle **611** can be increased by L2-L3, and the toner T is less likely to be compressed.

FIG. **22** illustrates a cap (outer cap) **2340**A according to another example of the second embodiment. The cap **2340**A is detachably attached to the outer surface **33***b* of the container opening **33***a*. The cap **2340**A seals the receiving opening **331** and the container opening **33***a* when attached to the outer surface **33***b* of the container opening **33***a*. The cap **2340**A includes an insertion part that is inserted in the receiving opening **331** and that has a different shape from that of the example as illustrated in FIG. **17** or the like.

An insertion part **3410** provided on the cap **2340**A of this example has a conical trapezoid shape such that the diameter increases from an opening position side to a closing position side of the container shutter **332**. An outer surface **3410***c* of the insertion part **3410** has a tapered shape such that the diameter increases from the opening position side to the closing position side of the container shutter **332**. Specifically, a diameter R1 of a portion **3410***b* of the insertion part **3410** on the closing position side is greater than a diameter R2 of an end portion **3410***a* of the insertion part **3410** on the opening position side. The diameter R1 is also greater than a diameter R3 of a hole (through hole) **333***a* provided in the

center of the ring-shaped container seal **333**. The diameter R**2** is smaller than the diameter R**3**.

The portion **3410***b* is a portion to be disposed inside the hole **333***a* of the container seal **333** when the insertion part **3410** is inserted in the receiving opening **331** and located at the attachment completed position.

With the insertion part **3410** in the shape as described above, even if variation of components or an assembly error occurs, the container seal **333** can be elastically deformed from the inside to the outside on the hole **333***a* side by the insertion part **3410** when the cap **2340**A is located at the attachment completed position. Therefore, the insertion part **3410** and the container seal **333** can prevent a gap from being generated at the hole **333***a*, so that the sealing performance can be maintainer or improved. Further, because the diameter R**2** is set to be smaller than the diameter R**3**, when the cap **2340**A is attached to the outer surface **33***b* of the container opening **33***a* (the container body **33**), the end portion **3410***a* can easily enter the hole **333***a* at the container seal **333** and the attachment performance can be improved. The shape of the insertion part **3410** is not limited to the conical trapezoid shape as long as it has a cross section in which the diameter increases from the opening position side to the closing position side. Therefore, a conical shape may be employed, for example.

FIG. **23** illustrates still another example of the second embodiment. In this example, a seal **2345** is provided at the end portion **2341***a* of the insertion part **2341** located on the opening position side in the cap **2340**. The seal **2345** may be made of an elastic material or a foamed material.

By providing the seal **2345** at the end portion **2341***a* of the insertion part **2341** that comes in contact with the end surface **332***h* of the container shutter **332**, it is possible to fill even a small space between the end portion **2341***a* and the end surface **332***h*. Therefore, when the cap **2340** is detached from the outer surface **33***b* of the container opening **33***a* (the container body **33**), toner accumulated in the small space between the end portion **2341***a* and the end surface **332***h* can be received or borne by the seal **2345**. Consequently, it is possible to prevent the toner from being discharged to the outside of the toner container **32**.

In particular, if a protrusion as illustrated in FIG. **19** is provided in order to reduce the contact area between the end surface **332***h* of the container shutter **332** and the end surface **611***a* of the conveying nozzle **611** to reduce frictional resistance, toner is likely to be accumulated in the small space. Even in this case, it is possible to receive or bear the accumulated toner by the seal **2345**, and prevent the toner from being discharged to the outside of the toner container **32**, which is preferable.

As described above, according to the second embodiment, the cap **2340** is provided with the insertion part **2341** that has the length L**2** so as to fill the space (movement space) S**3** of the moving region L**1** of the container shutter **332** inside the container shutter supporter **334**, and prevents the toner T from entering the space (movement space) S**3** when the cap **2340** is located at the attachment completed position during transportation of the toner container **32** or the like. Therefore, when the container shutter **332** moves to the closing position upon detachment of the cap **2340**, no toner T is present in the space (movement space) S**3** in which the container shutter **332** moves. Specifically, when the toner container **32** is set in the toner replenishing device **60**, almost no toner T enters the space (movement space) S**3** in which the container shutter **332** moves. Therefore, the toner T is not compressed upon movement of the container shutter **332** from the closing position to the opening position. Further, when the container shutter **332** moves back to the closing position, the movement is not disturbed by the compressed toner T. Therefore, it is possible to prevent the toner container **32** from being detached while the receiving opening **331** remains open, enabling to prevent toner leakage.

According to an embodiment of the present invention, the inner cap is provided that covers the sealing portion and the supporter of the opening/closing member at least when the opening/closing member is located at the closing position. Therefore, it is possible to prevent the toner from entering an opening/closing region of the opening/closing member. Consequently, it is possible to prevent a situation in which the opening/closing member is prevented from moving to the closing position by the toner.

Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

What is claimed is:

1. A nozzle receiver for use with a powder container, the nozzle receiver comprising:

a shutter to open an opening of the nozzle receiver to an opening position when the shutter is pressed by a conveying nozzle of an image forming apparatus, and to close the opening to a closing position when not being pressed by the conveying nozzle, and that includes a sealing portion for sealing the opening;

a supporter to support the shutter between the opening position and the closing position; and

a movable cap to cover the supporter at a covering position when the shutter is at the closing position, and to expose the supporter at an exposing position when the shutter is at the opening position, the movable cap being movable between the covering position and the exposing position in correspondence to the shutter being in the closing position and the opening position.

2. The nozzle receiver according to claim **1**, wherein the movable cap moves with the shutter relative to the supporter.

3. The nozzle receiver according to claim **2**, wherein the movable cap includes an inner end surface that comes in contact with a part of the shutter when the shutter moves to the opening position.

4. The nozzle receiver according to claim **1**, wherein

the supporter supports the shutter between the opening position and the closing position in a longitudinal direction thereof, and

the movable cap covers the supporter along the longitudinal direction when the shutter is at the closing position.

5. The nozzle receiver according to claim **4**, wherein

the movable cap includes an inner side protrusion that protrudes from an inner surface of the movable cap to an outer surface of the supporter housed in the movable cap, and

the supporter includes a stopper that protrudes from the outer surface of the supporter to the inner surface of the movable cap.

6. The nozzle receiver according to claim **4**, wherein

the supporter includes an engaging groove that holds the movable cap when the movable cap is located at a closure position at which the movable cap longitudinally covers the supporter.

7. The nozzle receiver according to claim **4**, wherein the movable cap includes a seal that seals a gap between the

supporter and an inner surface of the movable cap when the movable cap is located at a closure position at which the movable cap longitudinally covers the supporter.

8. The nozzle receiver according to claim **4**, wherein the movable cap is in a form of a protrusion such that the movable cap protrudes from an end portion located distant from the sealing portion of the shutter in the longitudinal direction when the shutter is located at the closing position, and such that a projection area is reduced from an upstream side to a downstream side in a moving direction in which the shutter moves from the closing position to the opening position.

9. The nozzle receiver according to claim **1**, further comprising a spring that is provided at the supporter and that biases the shutter to the closing position.

10. A powder container comprising the nozzle receiver according to claim **1**.

11. The powder container according to claim **10**, wherein the powder is toner.

12. The powder container according to claim **10**, wherein the powder includes toner and carrier particles.

13. An image forming apparatus comprising:

the powder container according to claim **10**; and

the conveying nozzle that is inserted in the opening of the supporter along with attachment operation of the powder container and that receives the powder supplied from the powder container.

14. A powder container comprising:

a powder storage to store therein powder to be supplied to an image forming apparatus;

a rotary conveyor within the powder container which conveys powder within the powder storage;

a nozzle receiver attached to the powder storage, the nozzle receiver including,

a shutter to open an opening of the nozzle receiver to an opening position when the shutter is pressed by a conveying nozzle of an image forming apparatus, and to close the opening to a closing position when not being pressed by the conveying nozzle, and that includes a sealing portion for sealing the opening, and

a supporter to support the shutter between the opening position and the closing position in a longitudinal direction thereof; and

an outer cap attached to the powder storage which covers the nozzle receiver from outside of the powder container, and which includes an insertion part that is inserted in the supporter, wherein

the insertion part fills a space of the supporter which is a moving region of the shutter.

15. The powder container according to claim **14**, wherein the insertion part includes a conical shape or a conical trapezoid shape such that a diameter thereof is increased along the longitudinal direction of the supporter.

16. The powder container according to claim **14**, wherein a length of the insertion part in the longitudinal direction is longer than a length of a part of the conveying nozzle in the supporter.

17. The powder container according to claim **14**, wherein the outer cap includes a seal on an end portion of the insertion part on an opening position side.

18. The powder container according to claim **14**, wherein the powder is toner.

19. The powder container according to claim **14**, wherein the powder includes toner and carrier particles.

20. An image forming apparatus comprising:

the powder container according to claim **14**; and

the conveying nozzle that is inserted in the opening of the supporter along with attachment operation of the powder container and that receives the powder supplied from the powder container.

* * * * *